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AN INVESTIGATION OF A THERMAL ICE-PREVENTION SYSTEM FOR A C-46 CARGO AIRPLANE

VI - DRY-AIR PERFORMANCE OF THERMAL SYSTEM AT SEVERAL TWIN- AND SINGLE-ENGINE OPERATING CONDITIONS AT VARIOUS ALTITUDES

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WASHINGTON

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SUMMARY

As a part of a comprehensive investigation of a thermal ice-prevention system for a C-46 cargo airplane, flight tests have been conducted to establish the dry-air-performance characteristics of the system at various operating conditions and altitudes. Complete thermal data were recorded during twin-engine operation at various flight conditions and at pressure altitudes up to 29,000 feet. Representative thermal data were recorded for the wing outer panels during single-engine operation at various flight conditions and at pressure altitudes up to 18,000 feet.

The results of the twin-engine tests indicate that, for operation at pressure altitudes below 25,000 feet, the skin-temperature rises, above ambient-air temperature, of the heated-surface leading-edge regions at any test altitude, are about the same in magnitude, irrespective of the test flight conditions, and that the actual leading-edge skin temperatures will change little with altitude if a standard ambient-air-temperature gradient prevails.

The results of the single-engine tests indicate that the skin-temperature rises, above ambient-air temperature, were about the same, irrespective of the test altitudes and test conditions employed. The performance of the thermal system during single-engine operation indicates that sufficient heat is available for limited protection in natural-icing conditions.

INTRODUCTION

This report is the sixth of a series which describes a comprehensive investigation of a thermal ice-prevention system for a Curtiss-Wright C-46 cargo airplane. The first five reports of the series (references 1 through 5) describe the design and construction of the complete thermal ice-prevention system and present the results of flight tests in dry-air and in natural-icing conditions.

Previous tests (reference 4) provided information on the performance characteristics in dry air of the thermal ice-prevention system during twin-engine operation at pressure altitudes between 4000 and 18,000 feet. The purpose of the investigation reported herein was to extend this information to include a wider range of test altitudes and engine operating conditions, including single-engine operation.

This research was conducted at the Ames Aeronautical Laboratory as part of the general investigation of a thermal ice-prevention system for a C-46 cargo airplane, which was initiated at the request of the Air Technical Service Command, U.S. Army Air Forces.

DESCRIPTION OF EQUIPMENT

The thermal ice-prevention system installed in the Curtiss-Wright C-46 cargo airplane (Army serial No. 41-12293), shown in figure 1, is completely described in references 1, 2, and 3. The system was in the revised condition described in reference 4 during the tests reported herein. Detailed information on the design analysis of the thermal ice-prevention equipment, the general arrangement of which is shown in figure 2, is presented in reference 1. Reference 2 completely describes the design and construction details of the exhaust-gas-to-air heat exchangers employed in the system. Details of the construction of the thermal ice-prevention system and of the instrumentation provided to evaluate the performance of the system are contained in reference 3. Details of typical thermocouple and pressure-orifice installations are shown in figure 3, and an index to the instrumentation is presented as figure 4. The NACA temperature-selecting unit, described in reference 3,

was used during the twin-engine tests, and a Brown recording potentiometer was used during the single-engine tests for recording skin, air, and structure temperatures.

TESTS

During all the tests, the airplane was operated at approximately 39,000 pounds gross weight.

The tests for the evaluation of the characteristics of the thermal system during twin-engine operation of the airplane were conducted at the following flight conditions and altitudes:

Flight condition	Approximate pressure altitude (ft)
1. Level flight, engines operated at 2400 rpm and full throttle	29,000 25,000 18,000 14,000 6,000
2. Level flight, engines operated at: (a) 1900 rpm, full throttle (b) 1900 rpm, 55 percent maximum continuous power	25,000 18,000 14,000 6,000
3. Climb at approximately 130 mph, engines operated at 40 in. Hg manifold pressure and 2400 rpm	15,000 10,000 5,000

The performance tests of the thermal ice-prevention system during single-engine operation were conducted at the following altitudes and flight conditions:

Flight condition	Approximate pressure altitude (ft)
1. Approximately 115 mph indicated airspeed, single engine operated at maximum continuous power, flight attitude adjusted to give desired indicated airspeed	18,000 14,000 [1]13,000 10,000 5,000
2. Descent at about 400 feet per minute and approximately 140 mph indicated airspeed, single engine operated at 1900 rpm, manifold pressure as required	18,000 10,000 6,000
3. Level flight at approximately 130 mph, single engine operating at 2400 rpm, manifold pressure as required	10,000 5,000
4. Descent at approximately 130 mph indicated airspeed, single engine operated at 30 in. Hg manifold pressure and 1900 rpm	10,000

[1]Single-engine ceiling.

The tests were conducted at all the foregoing conditions with the right propeller feathered, and were repeated, at all these conditions except number 1, with the left propeller feathered. For the tests with the left propeller feathered, the venturi meter (venturi 12) in the crossover duct was reversed in order to measure the heated-air-flow rate from the right outboard heat exchanger to the left-wing outer panel. The crossover valves were opened in flight, prior to recording data, to distribute the heated air from the operating heat exchanger to both of the wing outer panels.

Complete data were recorded during the twin-engine tests to determine the heated-air-flow rates in the ducts, and the skin and air temperatures throughout the wing and empennage

thermal systems. For the single-engine tests, data were taken to determine representative skin and air temperatures for the left-wing outer panel, the heated-air-flow rates to both wing outer panels during operation of the left engine, and the heated-air-flow rate to the left-wing outer panel only during operation of the right engine.

Flight and engine operating conditions were held constant for a sufficient length of time prior to the recording of data to establish equilibrium conditions and assure the attainment of representative results.

RESULTS

The results of the twin-engine- and single-engine-performance tests are presented in tables I and II, respectively. Table I is arranged in 17 parts, similar to tables II through V of reference 4, to facilitate comparison with those results. The general flight data and the calculated heat flows are given in the first three parts of the table, and the temperature and heated-air-flow-rate data are presented in the remaining parts. Table II is arranged in five parts, with the general flight data and calculated heat flows presented in the first two parts, and the heated-air-flow rates and representative temperature data presented in the remaining parts. Sketches of the instrumented sections of the thermal ice-prevention system are provided in both tables. The temperatures given in tables I and II are actual temperatures, and the ambient-air temperature for each test is included in order that temperature-rise data may be readily evaluated. The ambient-air temperatures given have not been corrected for the effects of kinetic heating.

The thermocouples used to measure the skin temperatures were washer-type thermocouples (type 1 shown in fig. 3). These thermocouples are known to indicate erroneous skin temperatures when the washer is in contact with flowing heated air. This condition exists for all of the washer-type thermocouples installed in the leading-edge regions of the heated surfaces forward of the baffle plates. The magnitude of this error for thermocouples S19, S20, and S23 on the underside of the wing at station 159 has been established as about 25° F, with the airplane operating at 1900 rpm, 55-percent maximum-continuous-power cruise conditions (reference 4). Therefore, all of the skin temperatures

given in the tables and figures for regions forward of the baffle plate are probably considerably higher than the true skin temperatures.

Representative results of the full-throttle 2400-rpm (condition 1) twin-engine level-flight tests have been plotted in figures 5 to 11. Figure 5 illustrates the variation with altitude of the flow rates and temperatures of the air delivered to the left-wing outer panel, the right stabilizer, and the vertical fin, and also the variation with altitude of manifold pressure and indicated airspeed. Figure 6 presents the spanwise skin-temperature variation at 0 percent chord of the left-wing outer panel. Figures 7 through 10 present, respectively, the chordwise skin- and air-temperature distribution at wing stations 159 and 380, stabilizer station 125, and fin station 124. Figure 11 illustrates the variation with altitude of the average skin temperature forward of the baffle plates for the left-wing outer panel, the right stabilizer, and the vertical fin. The ambient-air-temperature variation with altitude for the full-throttle tests is also included in figure 11.

The chordwise air- and skin-temperature variations at wing station 380 are presented in figure 12 for the single-engine-operation tests conducted at 10,000 feet pressure altitude.

DISCUSSION

The data presented in the tables and curves of this report indicate the effect of the various twin- and single-engine operating conditions on the performance characteristics (skin temperatures, air temperatures, air-flow rates, and structure temperatures) of the thermal ice-prevention system at various altitudes. The most important of these characteristics are the structure temperatures from a standpoint of safety, and the skin temperatures from a standpoint of protection in natural-icing conditions. The skin and structure temperatures are discussed hereafter.

Twin-Engine Tests

The skin-temperature rise (above ambient-air temperature) as indicated by any specific thermocouple in the leading-edge regions of the heated surfaces was about the same,

irrespective of the test flight conditions employed at any test altitude below 25,000 feet pressure altitude (table I). Curves (figs. 5 to 11) which illustrate the characteristics of the thermal system at various altitudes have, therefore, been plotted for the full-throttle 2400-rpm (condition 1) tests only. The change with altitude of the average actual skin temperatures of the leading-edge regions of the wing, stabilizer, and fin heated surfaces forward of the baffle plates (fig. 11) was less than 30° F for the altitude range below 25,000 feet pressure altitude. The rapid decrease of these average temperatures above 25,000 feet pressure altitude is of little concern, since the normal operating altitude range of the C-46 cargo airplane is well below 25,000 feet pressure altitude. The ambient-air temperatures for these tests, plotted in figure 11, did not correspond to standard ambient-air temperature; however, the ambient-air-temperature gradient which prevailed did correspond closely to the standard ambient-air-temperature gradient (0.00356° F/ft). Thus, for the altitude range below 25,000 feet pressure altitude, the actual leading-edge skin temperatures would vary little at any of the test flight conditions and altitudes if a standard ambient-air-temperature gradient prevailed.

The temperature of the primary structure of the left-wing outer panel was measured at stations 24 and 159 during the twin-engine tests (pts. 6 and 8 of table I). The temperatures of the front spar and the hat-section stringers were never over 134° F. The temperatures of the nose ribs did not exceed 266° F, which is considered high but not excessive for this region of the wing structure.

Single-Engine Tests

The skin-temperature rises (above ambient-air temperature) measured for the left-wing outer panel (table II and fig. 12) were about the same, irrespective of test altitudes and flight conditions and irrespective of which engine was operated. Thus, if the actual skin temperatures were referred to a standard ambient-air-temperature gradient, they would decrease at approximately the same rate as the standard ambient-air-temperatures decrease with altitude.

While it has been established that the thermal ice-prevention system provided satisfactory protection in all natural-icing conditions to which it has been subjected

(reference 4), no previous data have been obtained during single-engine operation. A comparison of the reduced-heat data of reference 4 with the single-engine-operation data reported herein, however, permits an estimate to be made of the degree of ice protection that would be obtained during flight in natural-icing conditions when one engine has failed.

The average heat supplied to each wing outer panel during the single-engine tests was about 140,000 Btu per hour at an average temperature rise above ambient-air temperature of about 330° F (pts. 2 and 3 of table II). The heat flows to the left-wing outer panel given in table V of reference 4, which provided protection in natural-icing conditions, ranged from slightly above this amount to considerably below, and the heated-air-temperature rises above ambient-air temperature were lower. The indicated airspeeds at which the data of reference 4 were taken were considerably higher than those used during the single-engine-operation tests. Thus, a lower external heat-transfer coefficient would prevail during single-engine operation, and a smaller quantity of heat would be required for protection. Therefore, it is evident that limited protection would be realized in natural-icing conditions when one engine has failed. This limited protection would be adequate for icing conditions similar to those encountered during the tests reported in reference 4; however, it probably would not be sufficient to protect the airplane in icing conditions of greater severity. This comparison, and the conclusions drawn therefrom, are for the wing outer panels only; however, since the characteristics of the empennage system are similar, the conclusions are probably valid for the entire airplane.

CONCLUSIONS

The following conclusions are based upon the test results reported herein and comparison of these results with data previously obtained during flights in natural-icing conditions:

1. During the twin-engine tests, the skin-temperature rises, above ambient-air temperature, of the heated-surface leading-edge regions were about the same in magnitude, irrespective of the test conditions at any test altitude below 25,000 feet pressure altitude.

2. During twin-engine operation, below 25,000 feet pressure altitude, the actual leading-edge skin temperatures

of the heated surfaces will change little with altitude for the test conditions if a standard ambient-air-temperature gradient prevails.

3. During the single-engine tests, the skin temperature rises, above ambient-air temperature, of the heated-surface leading-edge regions were about the same in magnitude, irrespective of the test conditions and the test altitudes.

4. The performance of the thermal system during single-engine operation indicates that limited protection from ice can be obtained in natural-icing conditions when one engine has failed.

Ames Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Moffett Field, Calif.

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FLIGHT CONDITIONS (SEE TEXT)	FLIGHT NO.	RUN NO.	PRESSURE ALTITUDE (ft)	CORRECTED INDICATED AIRSPEED (m p h)	MANIFOLD PRESSURE (in.Hg)	R P M	AMBIENT AIR (°F)	SUPER-CHARGER BLOWER SETTING	FLIGHT ATTITUDE
1	70	2	29,150	117	23	2400	-37	HIGH	LEVEL
	70	3	24,800	148	28	2400	-17	HIGH	
	70	5	18,100	170	32	2400	13	HIGH	
	70	7	14,300	198	43	2400	31	HIGH	
	70	9	6,275	212	43	2400	50	LOW	
2	70	4	24,700	133	22	1900	-17	HIGH	LEVEL
	70	6	18,050	155	28	1900	13	HIGH	
	70	8	14,000	167	31	1900	29	HIGH	
	70	10	6,200	179	32	1900	47	LOW	
3	71	1	5,000	135	39.5	2400	41	LOW	CLIMB
	71	2	10,000	128	40	2400	29	HIGH	
	71	3	15,000	126	40	2400	15	HIGH	

PART I.— OPERATING CONDITIONS

TABLE I

PERFORMANCE OF C-46 AIRPLANE THERMAL ICE PREVENTION SYSTEM DURING TWIN ENGINE OPERATION

A-33

FLIGHT NO.	RUN NO.	EXCHANGER HEAT FLOWS (1000 BTU/HR)			HEAT FLOWS TO HEATED SURFACES (1000 BTU/HR)			
		① LEFT OUTBOARD	② LEFT INBOARD	③ RIGHT INBOARD	LEFT WING OUTER PANEL	RIGHT STABILIZER	FIN	TO SECONDARY EXCHANGER
70	2	273	261	124	273	52	86	72
70	3	337	346	144	337	72	114	86
70	5	393	401	156	393	82	132	84
70	7	446	422	193	446	97	138	104
70	9	521	445	236	521	127	123	122
70	4	284	265	136	284	62	100	75
70	6	354	355	131	354	73	116	79
70	8	394	386	125	394	88	86	84
70	10	448	437	155	448	105	101	100
71	1	399	378	123	399	85	75	94
71	2	369	348	109	369	73	68	88
71	3	342	277	102	342	75	62	83

① TEMPERATURE RISE USED TO CALCULATE HEAT TRANSFERRED = [(A_{62}) - (AMBIENT-AIR TEMPERATURE)] °F
② TEMPERATURE RISE USED TO CALCULATE HEAT TRANSFERRED = [(A_{66}) - (AMBIENT-AIR TEMPERATURE)] °F
③ —— PORTION OF RIGHT INBOARD HEAT-EXCHANGER FLOW RATE MEASURED AT VENTURI NO. 3

PART 2 - HEAT DISTRIBUTION.

TABLE I (CONTINUED)

FLIGHT NO.	RUN NO.	AVERAGE HEAT DELIVERED PER SQUARE FT. OF DOUBLE SKIN LEADING EDGE SURFACE (BTU / HR)			AVERAGE HEAT FLOW THRU HEATED SKIN SURFACE PER SQUARE FT. OF DOUBLE SKIN SURFACE (BTU/HR)			RATIO OF HEAT FLOW THRU HEATED SKIN SURFACE TO HEAT DELIVERED			④AVERAGE TEMP. RISE OF WING OUTER PANEL 0% CHORD (°F)
		LEFT WING OUTER PANEL	RIGHT STABILIZER	VERTICAL FIN	①LEFT WING OUTER PANEL	②RIGHT STABILIZER	③VERTICAL FIN	LEFT WING OUTER PANEL	RIGHT STABILIZER	VERTICAL FIN	
70	2	2,580	2,420	4,800	1,000	1,000	2,480	0.39	0.41	0.52	185
70	3	3,190	3,350	6,350	1,250	1,200	3,280	.39	.36	.52	180
70	5	3,720	3,820	7,350	1,490	1,520	3,900	.40	.40	.53	163
70	7	4,220	4,520	7,700	1,720	2,020	4,110	.41	.45	.53	152
70	9	4,960	5,920	6,860	1,940	2,560	3,740	.39	.43	.54	136
70	4	2,690	2,880	5,580	970	1,180	3,000	.36	.41	.54	160
70	6	3,350	3,400	6,460	1,270	1,470	3,440	.38	.43	.53	157
70	8	3,720	4,100	4,800	1,440	1,800	2,630	.39	.44	.56	154
70	10	4,150	4,880	5,630	1,590	2,150	3,070	.38	.44	.55	142
71	1	3,780	3,950	4,180	1,420	1,690	2,220	.38	.43	.53	151
71	2	3,500	3,680	3,790	1,290	1,540	2,000	.37	.42	.53	167
71	3	3,240	3,480	3,450	1,200	1,460	1,860	.37	.42	.54	171

① CALCULATED ON BASIS OF AVERAGE TEMPERATURE DROP OF THE HEATED AIR IN THE CORRUGATIONS AT STAS. 24, 84, 159, 290 AND 380 AND THE TOTAL AIR-FLOW RATE FROM THE LEFT OUTBOARD EXCHANGER

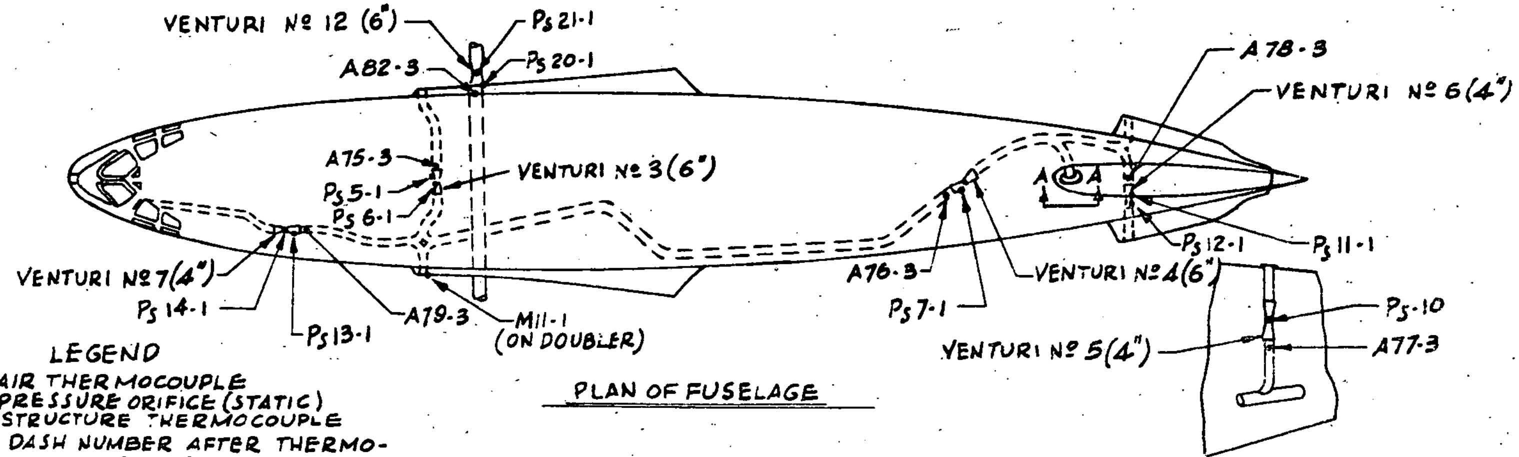
② CALCULATED ON BASIS OF AVERAGE TEMPERATURE DROP OF THE HEATED AIR IN THE CORRUGATIONS AT STATIONS 69, 125, AND 171 AND THE TOTAL HEATED-AIR-FLOW RATE TO THE RIGHT STABILIZER

③ CALCULATED ON BASIS OF AVERAGE TEMPERATURE OF THE HEATED AIR IN THE CORRUGATIONS AT STATIONS 124 AND 170 AND THE TOTAL HEATED-AIR-FLOW RATE TO THE VERTICAL FIN.

④ AVERAGE 0% CHORD LEADING EDGE TEMPERATURES AT STATIONS 24, 84, 159, 290 AND 380.

PART 3.–SURFACE HEATING VALUES.
TABLE I (CONTINUED)

A-33



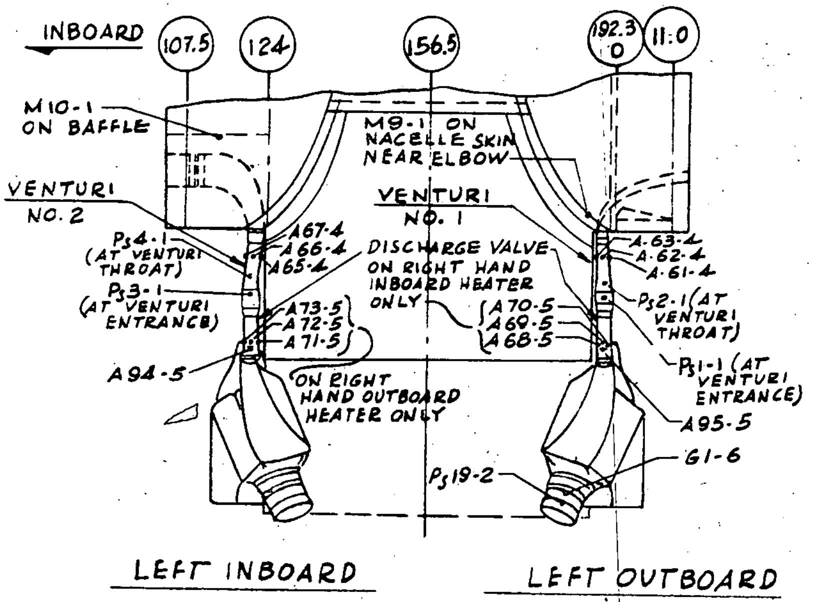
PLAN OF FUSELAGE

LEGEND

A - AIR THERMOCOUPLE
P_S - PRESSURE ORIFICE (STATIC)
M - STRUCTURE THERMOCOUPLE
DASH NUMBER AFTER THERMOCOUPLE OR PRESSURE ORIFICE NUMBER DENOTES TYPE OF MOUNTING
FOR MOUNTING TYPE DETAILS SEE FIGURE 3

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	VENTURI FLOW RATES (LB/HR) NO.3	NO.4	NO.5	NO.6	NO.7	NO.12	TEMPERATURE (°F) A75	A76	A77	A78	A79	A82	M11
70	2	-37	795	1,360	665	410	515	0	587	525	483	479	530	283	103
70	3	-17	850	1,835	850	535	620	0	656	550	523	523	540	254	100
70	5	13	1,070	2,640	1,230	765	805	0	594	465	449	450	440	256	94
70	7	31	1,605	3,230	1,410	980	1,030	0	517	445	430	435	441	238	103
70	9	50	2,760	4,150	1,480	1,480	1,425	0	400	406	390	400	408	238	143
70	4	-17	905	1,770	820	505	590	0	584	496	478	480	492	239	100
70	6	13	885	2,290	1,070	675	770	0	603	470	451	451	434	238	99
70	8	29	870	2,425	865	855	875	0	605	466	436	446	420	249	120
70	10	47	1,245	3,120	1,080	1,115	1,100	0	547	441	427	430	417	243	162
71	1	41	1,325	2,790	900	1,010	1,040	0	420	404	381	385	408	235	180
71	2	29	1,065	2,265	725	840	865	0	446	427	410	414	442	254	182
71	3	15	905	2,005	625	745	765	0	474	444	423	426	456	263	182

PART 4.- FUSELAGE AIR-FLOW RATES, AIR TEMPERATURES, & DOUBLER TEMPERATURES.
TABLE I (CONTINUED)



LEGEND

A - AIR THERMOCOUPLE
M - STRUCTURE THERMOCOUPLE
P_S - PRESSURE ORIFICES (STATIC)
P_T - PRESSURE ORIFICES (TOTAL)

DASH NUMBER AFTER THERMOCOUPLE OR PRESSURE ORIFICE NUMBER DENOTES TYPE OF MOUNTING

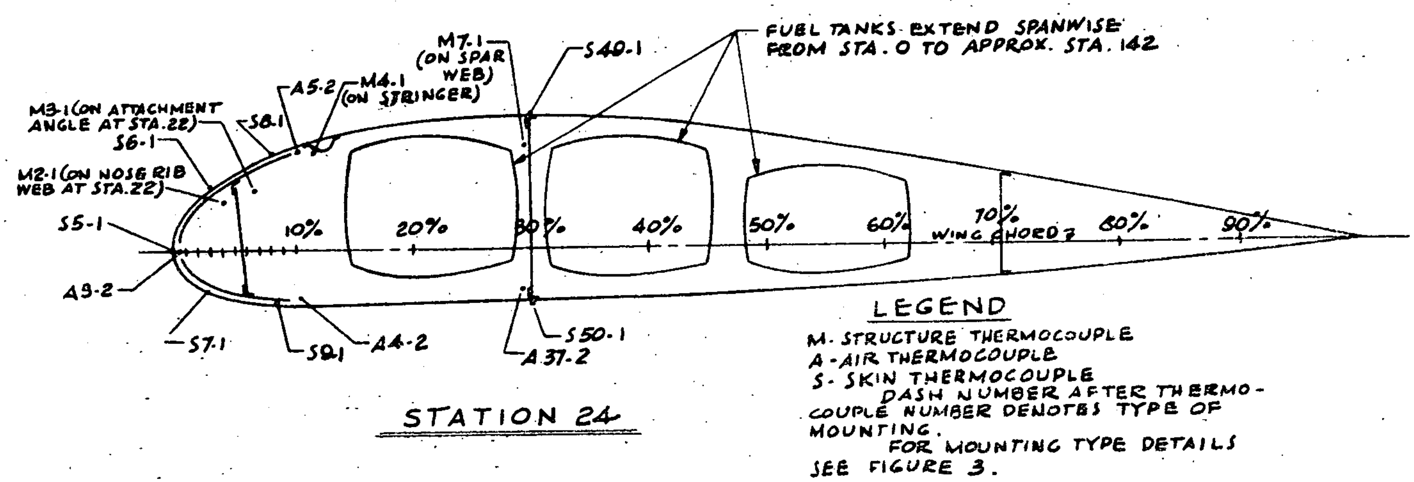
FOR MOUNTING TYPE DETAILS SEE FIGURE 3

THERMOCOUPLES NOS. A-68 TO A-73 INCL. ON RIGHT HAND NACELLE ONLY

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	VENTURI FLOW RATES (LBS/HR)		TEMPERATURE (°F)																	
			① NO. 1	② NO. 2	A61	A62	A63	A85	A65	A66	A67	A94	M10	M9	A68	A69	A70	A71	A72	A73
70	2	-37	2,385	1,565	--	432	371	--	--	624	586	--	318	92	592	634	694	380	471	474
70	3	-17	3,380	2,340	--	390	338	--	--	574	543	--	333	78	625	692	717	362	426	431
70	5	13	4,610	3,620	--	362	312	360	--	463	429	--	274	84	569	623	656	327	365	376
70	7	31	5,580	3,985	--	359	313	364	--	461	428	--	279	92	483	544	574	316	350	363
70	9	50	7,500	4,550	--	335	281	336	--	447	420	--	294	94	356	420	463	300	330	345
70	4	-17	3,090	2,060	--	360	292	--	--	502	454	--	296	74	483	600	649	291	366	390
70	6	13	4,165	3,170	--	361	300	390	--	467	412	--	274	89	575	628	682	287	340	363
70	8	29	4,550	3,620	--	383	323	380	--	460	407	--	282	98	606	638	696	297	345	359
70	10	47	5,980	4,440	--	354	286	354	--	447	396	--	280	106	549	564	610	278	320	340
71	1	41	5,310	3,820	--	350	310	368	--	444	416	--	278	99	400	453	490	310	353	364
71	2	29	4,440	3,190	--	370	330	402	--	470	443	--	295	102	433	479	525	928	378	382
71	3	15	3,920	2,900	--	372	331	396	--	405	464	--	297	93	494	508	555	365	490	410

① FLOW RATE CALCULATION BASED ON A62 AT VENTURI NO. 1
② FLOW RATE CALCULATION BASED ON A66 AT VENTURI NO. 2

PART 5.- HEAT-EXCHANGER AIR TEMPERATURES AND FLOW RATES.
TABLE I (CONTINUED)

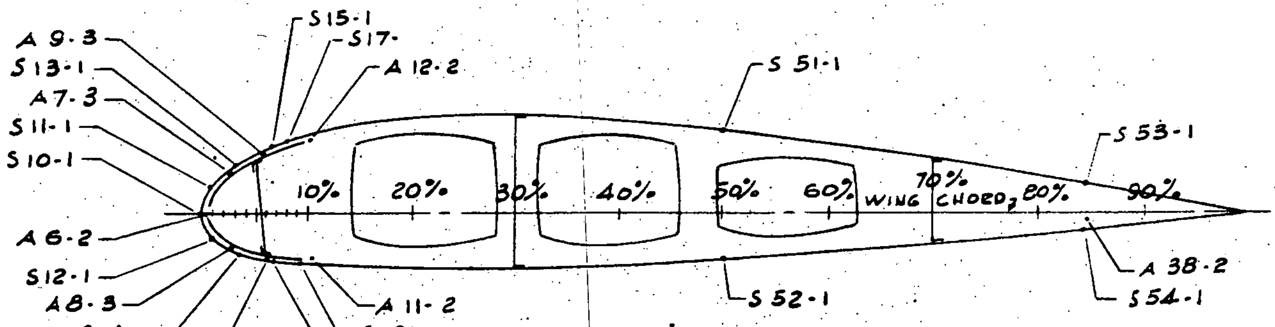


STATION 24

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)														
			S49	S8	S6	S5	S7	S9	S50	A5	A3	A4	A37	M2	M3	M4	M7
70	2	-37	5	50	100	175	145	83	-22	88	293	93	0	266	208	58	41
70	3	-17	21	65	114	178	139	74	1	102	277	91	21	259	195	76	43
70	5	13	46	99	152	193	141	90	30	126	274	107	39	263	199	100	54
70	7	31	61	103	155	196	141	104	42	140	275	121	63	262	205	110	67
70	9	50	79	113	155	196	145	118	61	152	264	133	73	254	199	126	83
70	4	-17	15	59	105	160	131	83	-1	91	248	91	15	239	184	67	42
70	6	13	48	94	151	187	157	101	26	128	265	110	41	255	201	99	60
70	8	29	60	105	151	198	165	108	40	133	282	121	61	264	211	110	68
70	10	47	75	111	153	194	152	115	53	151	269	135	76	264	206	121	85
71	1	41	69	99	128	199	163	118	47	136	269	130	68	253	200	110	70
71	2	29	61	93	128	205	169	116	36	133	285	130	58	261	209	106	68
71	3	15	48	82	116	197	155	103	20	125	280	120	50	255	203	93	65

PART 6.-WING OUTER PANEL (STATION 24) SKIN, STRUCTURE, AND AIR TEMPERATURES.

TABLE I (CONTINUED)



STATION 84

LEGEND

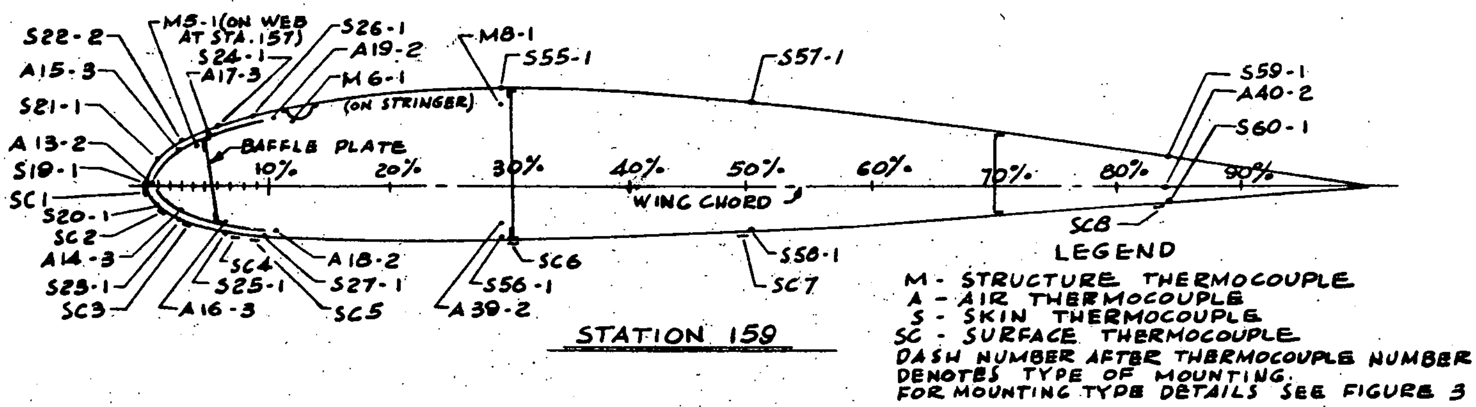
A· AIR THERMOCOUPLE
S· SKIN THERMOCOUPLE
DASH NUMBER AFTER THERMOCOUPLE DENOTES TYPE OF MOUNTING
FOR MOUNTING TYPE DETAILS SEE FIGURE 3.

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)																				
			S53	S51	S17	S15	S13	S11	S10	S12	S14	S16	S18	S52	S54	A12	A9	A7	A6	A8	A10	A11	A38
70	2	-37	-7	-9	42	75	136	125	161	142	158	110	80	-8	-25	69	113	184	288	174	155	93	-2
70	3	-17	5	1	61	82	136	136	167	152	170	114	84	10	-9	87	124	184	277	187	162	102	11
70	5	13	26	25	86	103	152	157	178	171	183	103	89	30	21	110	146	194	271	202	176	115	26
70	7	31	45	39	95	112	155	163	186	180	191	106	100	47	37	127	155	197	276	211	185	131	43
70	9	50	58	58	111	121	155	171	187	184	178	114	115	64	53	135	160	188	263	207	177	136	56
70	4	-17	5	-7	48	70	120	120	146	135	153	121	105	4	-10	75	106	162	248	165	153	113	8
70	6	13	28	25	85	102	152	160	173	168	184	131	100	32	19	110	141	185	264	192	170	113	26
70	8	29	42	43	99	113	157	166	184	178	201	128	103	47	36	120	150	199	275	208	185	131	42
70	10	47	58	61	107	121	157	168	193	186	198	125	114	67	53	137	163	194	269	213	192	144	60
71	1	41	52	50	103	120	168	184	197	182	193	152	123	53	49	133	161	206	263	210	193	140	53
71	2	29	42	39	95	119	175	187	197	184	195	154	124	44	35	129	163	214	276	211	198	145	45
71	3	15	24	26	80	106	163	171	190	169	182	142	109	30	20	118	153	206	276	201	188	135	32

PART 7.- WING OUTER PANEL (STATION 84) SKIN AND AIR TEMPERATURES.

TABLE I (CONTINUED)

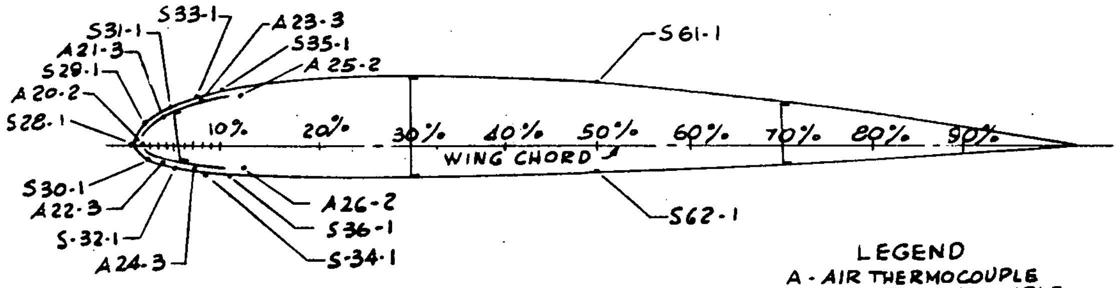
A-33



FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)																										
			S59	S57	S55	S26	S24	S22	S21	S19	S20	S23	S25	S27	S56	S58	S60	A19	A17	A15	A13	A14	A16	A18	A39	A40	M6	M5	M8
70	2	-37	-16	-14	1	63	122	164	145	151	145	158	140	104	-15	-21	-26	88	155	196	276	164	166	109	4	-20	51	228	91
70	3	-17	0	5	15	80	115	165	151	157	155	163	140	101	1	-3	-9	115	165	198	273	173	178	113	23	-4	79	226	34
70	5	13	23	26	38	126	152	182	173	168	173	167	126	90	26	23	18	141	186	216	267	188	185	105	46	20	110	236	58
70	7	31	42	47	60	131	157	189	178	176	185	177	134	100	50	39	35	156	196	221	272	199	196	117	68	38	123	240	75
70	9	50	55	63	74	145	165	195	189	183	187	175	136	112	67	59	50	166	200	221	262	197	197	128	83	54	134	240	92
70	4	-17	-4	1	11	89	117	151	135	136	140	145	131	106	0	-9	-10	105	150	178	240	156	158	106	20	-8	74	207	30
70	6	13	24	30	40	121	152	186	173	165	173	169	134	96	32	21	18	141	182	208	259	182	177	104	50	21	110	238	60
70	8	29	40	42	55	130	159	194	182	178	184	176	139	105	51	37	38	156	187	218	274	194	194	115	68	42	126	248	73
70	10	47	57	65	74	138	163	194	188	187	192	182	145	112	66	58	50	163	198	221	265	199	199	130	86	57	131	243	94
71	1	41	50	56	65	125	156	192	187	187	187	187	170	137	60	49	47	153	188	224	268	203	204	140	78	52	121	230	88
71	2	29	39	43	58	118	159	197	192	190	190	192	170	135	50	37	35	150	197	229	280	206	208	150	70	40	114	243	83
71	3	15	21	27	42	109	153	189	176	182	172	176	159	121	34	22	18	140	190	224	272	193	197	140	58	24	100	236	68

PART 8.- WING OUTER PANEL (STATION 159) SKIN, STRUCTURE, AND AIR TEMPERATURES.

TABLE I (CONTINUED)



STATION 290

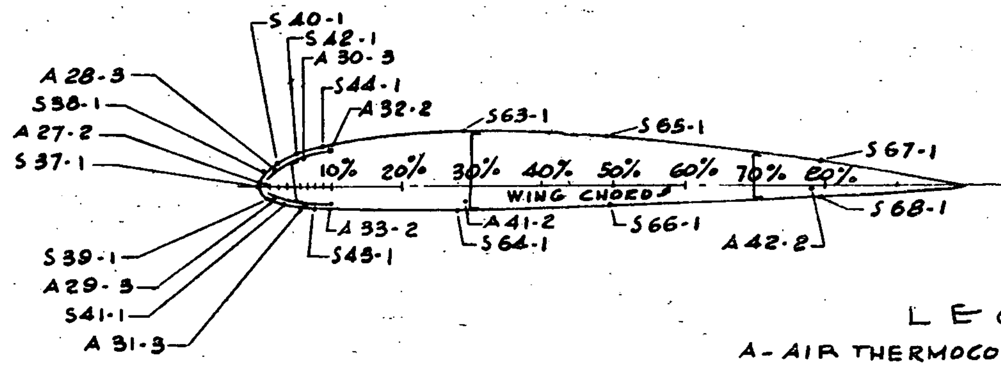
LEGEND
A - AIR THERMOCOUPLE
S - SKIN THERMOCOUPLE
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING.
FOR MOUNTING TYPE DETAILS SEE FIGURE 3.

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)																	
			S61	S35	S33	S31	S29	S28	S30	S32	S34	S36	S62	A25	A23	A21	A20	A22	A24	A26
70	2	-37	-11	89	152	174	158	151	150	171	146	127	-24	93	178	188	291	192	167	145
70	3	-17	4	117	151	173	162	158	160	178	151	121	-6	138	194	196	289	201	180	154
70	5	13	26	163	180	194	184	172	176	193	165	126	24	163	211	211	280	215	187	156
70	7	31	43	164	178	199	187	182	186	189	142	105	45	168	216	220	284	227	194	153
70	9	50	59	171	187	197	197	188	194	187	143	113	63	173	216	227	267	223	187	162
70	4	-17	1	121	145	161	146	139	140	159	137	123	-9	124	172	172	258	178	158	140
70	6	13	28	158	178	190	183	166	177	189	163	133	26	163	200	203	269	206	183	153
70	8	29	42	157	180	195	188	182	192	199	174	145	46	167	215	216	290	226	194	166
70	10	47	59	166	185	200	197	189	198	205	174	136	63	176	219	221	271	223	192	163
71	1	41	53	145	185	203	197	195	192	205	185	171	53	158	207	225	277	228	207	186
71	2	29	42	137	182	205	199	197	192	207	185	171	41	156	215	228	289	229	208	190
71	3	15	28	125	168	191	185	185	175	192	171	156	23	142	203	215	282	217	198	180

PART 9.- WING OUTER PANEL (STATION 290) SKIN AND AIR TEMPERATURES.

TABLE I (CONTINUED)

A-33



STATION 380

LEGEND

A - AIR THERMOCOUPLE

S - SKIN THERMOCOUPLE

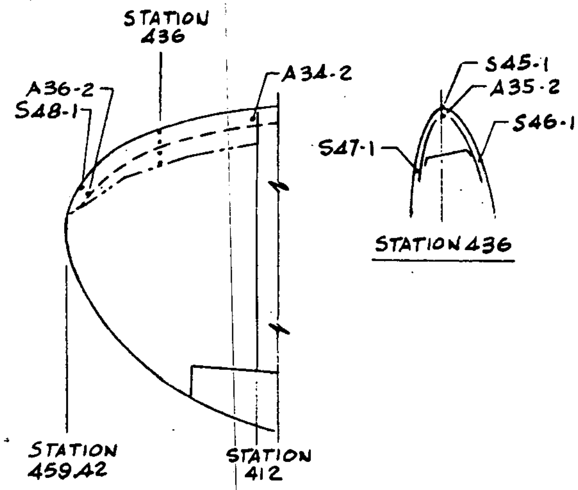
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING.

FOR MOUNTING TYPE DETAILS SEE FIGURE 3.

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)																					
			S67	S65	S63	S44	S42	S40	S38	S37	S39	S41	S43	S64	S66	S68	A32	A30	A28	A27	A29	A31	A33	A41	A42
70	2	-37	-11	-9	4	83	125	176	189	154	178	160	140	5	-19	-25	131	177	218	314	213	167	167	37	-3
70	3	-17	4	5	20	112	140	182	195	155	187	173	136	11	-2	8	138	196	227	304	220	178	172	48	-5
70	5	13	26	32	42	151	168	199	211	169	198	178	111	40	24	20	150	209	231	294	228	179	173	71	20
70	7	31	44	50	60	156	173	206	217	173	208	170	113	60	42	38	162	—	241	294	239	173	174	90	40
70	9	50	59	64	76	135	170	205	221	176	187	162	126	74	57	53	165	217	239	274	229	168	173	104	52
70	4	-17	1	4	14	117	135	164	177	136	167	156	136	7	-3	-10	128	173	197	267	193	158	157	38	-8
70	6	13	26	34	45	150	168	201	212	157	200	184	138	40	24	20	151	199	225	281	219	170	166	70	24
70	8	29	45	52	60	161	178	201	221	173	212	194	139	60	39	35	157	216	242	297	235	187	184	85	37
70	10	47	57	63	78	162	179	211	221	182	211	190	126	75	57	52	170	221	241	284	235	180	182	107	57
71	1	41	53	60	70	167	186	215	222	185	213	205	185	70	51	48	177	213	245	292	229	210	208	104	52
71	2	29	42	48	63	164	187	218	229	191	215	208	184	62	40	37	182	226	251	303	241	212	212	99	40
71	3	15	26	32	48	153	173	203	213	179	197	190	170	46	24	20	171	213	240	300	229	200	200	85	26

PART 10.-WING OUTER PANEL (STATION 380) SKIN AND AIR TEMPERATURES.

TABLE I (CONTINUED)



WING TIP

LEGEND

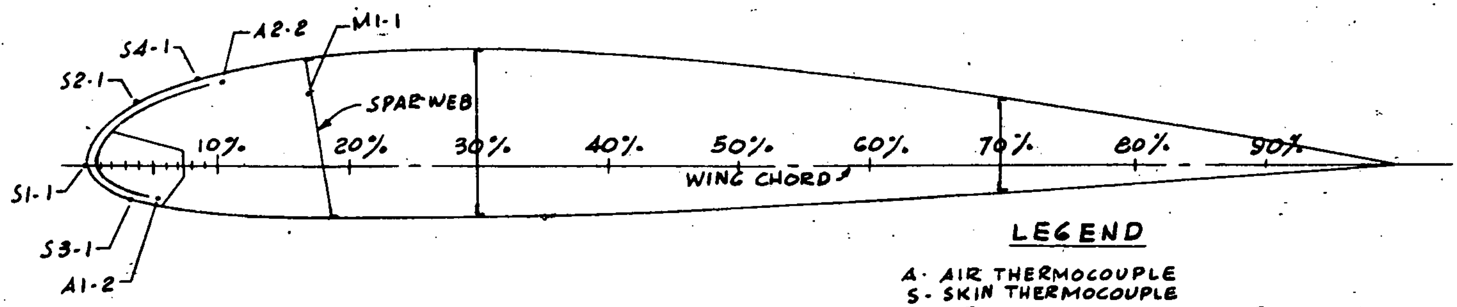
A - AIR THERMOCOUPLE
S - SKIN THERMOCOUPLE
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING
FOR MOUNTING DETAILS SEE FIGURE 3.

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)						
			A34	S48	A36	S46	S45	S47	A35
70	2	-37	268	42	215	157	63	153	247
70	3	-17	264	65	230	144	73	146	250
70	5	13	260	76	233	142	96	147	254
70	7	31	267	84	240	159	106	163	259
70	9	50	256	94	230	178	120	182	250
70	4	-17	232	58	205	154	64	152	220
70	6	13	255	84	223	165	91	168	243
70	8	29	266	92	243	184	106	182	257
70	10	47	260	96	238	194	122	192	256
71	1	41	257	109	232	163	124	161	260
71	2	29	274	100	250	201	118	194	268
71	3	15	263	83	237	213	104	207	258

PART II.-WING TIP SKIN AND AIR TEMPERATURES

TABLE I (CONTINUED)

A-33



STATION 90

LEGEND

A - AIR THERMOCOUPLE
S - SKIN THERMOCOUPLE
M - STRUCTURE THERMOCOUPLE

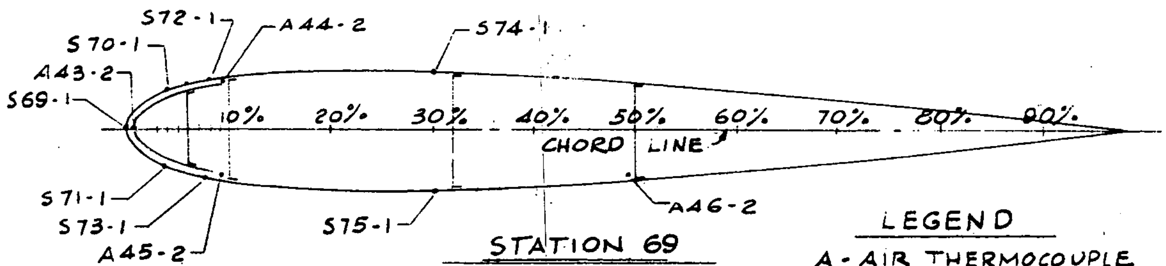
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING

FOR MOUNTING TYPE DETAILS SEE FIGURE 3.

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)						
			S4	S2	S1	S3	A2	A1	M1
70	2	-37	0	12	188	160	11	229	11
70	3	-17	23	48	217	194	37	280	28
70	5	13	50	79	206	170	66	255	58
70	7	31	65	86	218	170	88	262	59
70	9	50	86	104	232	179	113	277	79
70	4	-17	22	58	193	178	37	250	26
70	6	13	50	76	200	178	65	255	52
70	8	29	60	84	208	180	78	257	63
70	10	47	79	92	218	175	102	266	84
71	1	41	74	85	222	192	90	265	75
71	2	29	65	78	227	202	81	273	71
71	3	15	51	66	220	195	65	268	63

PART 12.- WING CENTER PANEL (STATION 90) SKIN AND AIR TEMPERATURES.

TABLE I (CONTINUED)



STATION 69

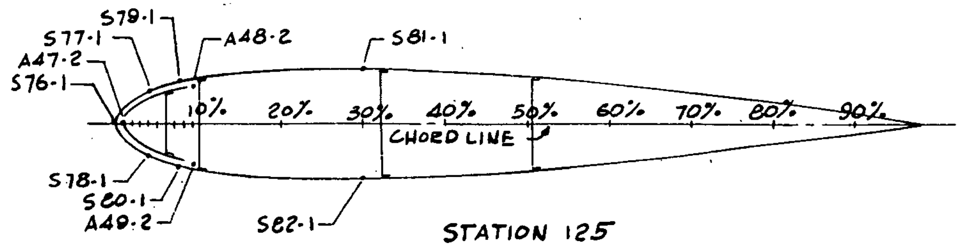
LEGEND

A - AIR THERMOCOUPLE
S - SKIN THERMOCOUPLE
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING
FOR MOUNTING TYPE DETAILS SEE FIGURE 3

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)										
			S74	S72	S70	S69	S71	S73	S75	A44	A43	A45	A46
70	2	-37	-14	100	162	112	134	80	-23	60	332	42	-25
70	3	-17	1	141	204	154	177	94	-9	102	388	68	-9
70	5	13	26	149	216	173	182	78	10	120	366	79	18
70	7	31	45	165	232	199	197	93	40	146	378	117	35
70	9	50	63	182	248	213	194	110	58	173	363	152	55
70	4	-17	1	134	189	145	164	106	-8	100	366	83	-10
70	6	13	28	151	210	168	175	91	21	115	360	79	18
70	8	29	48	170	232	193	197	107	38	152	380	116	32
70	10	47	53	173	243	211	210	113	55	160	380	143	54
71	1	41	52	106	221	194	195	123	50	156	344	142	48
71	2	29	42	170	227	197	201	132	38	156	365	150	40
71	3	15	28	165	218	185	192	137	21	147	368	140	21

PART 13.– STABILIZER (STATION 69) SKIN AND AIR TEMPERATURES.

TABLE I (CONTINUED)



STATION 125

LEGEND

A- AIR THERMOCOUPLE
S- SKIN THERMOCOUPLE

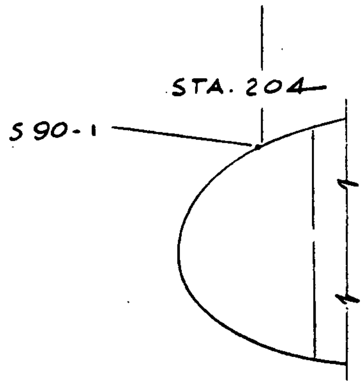
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING.

FOR MOUNTING TYPE DETAILS SEE FIGURE 3.

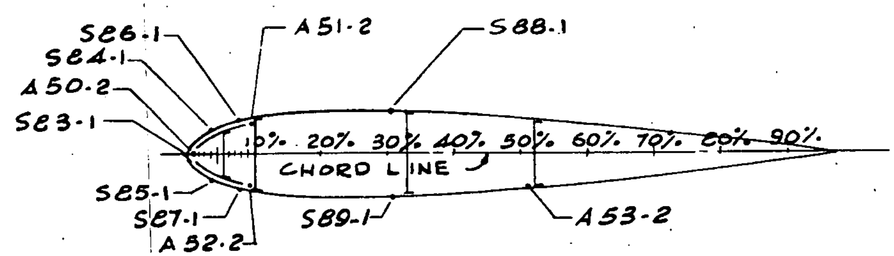
FLIGHT NO.	RUN NO.	AMBIENT AIR(°F)	TEMPERATURE (°F)									
			S81	S79	S77	S76	S78	S80	S82	A48	A47	A49
70	2	-37	-12	91	140	98	145	85	-22	98	313	107
70	3	-17	5	116	177	128	188	115	-4	131	365	154
70	5	13	35	126	178	141	193	99	26	142	333	158
70	7	31	53	139	197	159	204	102	45	158	340	171
70	9	50	71	157	205	170	207	115	64	178	335	187
70	4	-17	3	121	163	116	170	112	-5	132	333	145
70	6	13	33	128	178	141	190	131	22	140	332	168
70	8	29	50	144	191	153	208	121	38	157	349	182
70	10	47	64	156	208	170	217	121	60	177	349	189
71	1	41	61	134	182	155	197	139	53	154	314	184
71	2	29	50	136	185	156	202	145	42	154	331	186
71	3	15	34	125	176	145	190	135	26	139	330	173

PART 14.- STABILIZER (STATION 125) SKIN AND AIR TEMPERATURES.

TABLE I (CONTINUED)



TIP



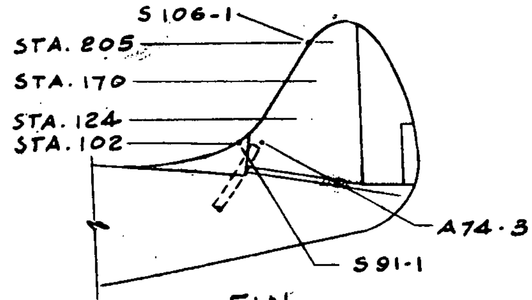
STATION 171

LEGEND
A - AIR THERMOCOUPLE
S - SKIN THERMOCOUPLE
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING
FOR MOUNTING TYPE DETAILS SEE FIGURE 3.

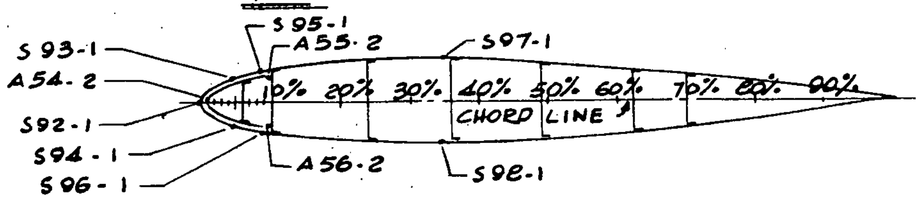
FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)											
			S90	S88	S86	S84	S83	S85	S87	S89	A51	A50	A52	A53
70	2	-37	66	-9	84	120	103	112	78	-20	119	272	110	-11
70	3	-17	99	11	110	157	136	156	100	0	157	323	146	9
70	5	13	125	32	121	167	152	154	87	26	173	300	149	40
70	7	31	146	52	133	185	168	170	99	45	184	300	162	55
70	9	50	160	67	146	192	173	175	109	62	197	293	175	74
70	4	-17	91	6	107	145	126	140	100	-4	146	294	136	6
70	6	13	121	33	128	168	148	157	99	23	169	297	146	38
70	8	29	139	44	136	177	166	173	109	40	181	306	164	59
70	10	47	157	63	151	197	175	182	111	57	199	306	177	74
71	1	41	137	58	132	171	157	164	106	53	176	273	160	67
71	2	29	134	48	133	175	160	167	114	42	181	288	165	57
71	3	15	119	32	130	165	146	156	107	26	169	287	155	40

PART 15.- STABILIZER (TIP AND STATION 171) SKIN AND AIR TEMPERATURES.

TABLE I (CONTINUED)



FIN



STATION 124

LEGEND

A - AIR THERMOCOUPLE

S - SKIN THERMOCOUPLE

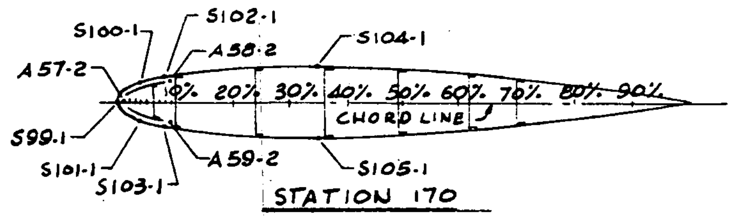
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING

FOR MOUNTING TYPE DETAILS SEE FIGURE 3.

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)												
			S91	S106	A74	S97	S95	S93	S92	S94	S96	S98	A55	A54	A56
70	2	-37	-27	135	436	-25	53	163	183	143	47	-27	114	394	67
70	3	-17	-6	167	482	-2	83	178	218	163	74	-7	154	438	102
70	5	13	24	173	428	26	103	195	218	169	96	22	167	400	130
70	7	31	37	177	415	39	115	186	216	178	113	41	176	390	147
70	9	50	59	165	374	54	115	173	192	163	110	55	168	352	141
70	4	-17	-10	152	442	-8	72	169	195	153	69	-9	141	410	93
70	6	13	23	170	429	24	97	184	215	168	94	18	164	394	121
70	8	29	32	151	417	38	88	167	194	159	93	35	150	376	115
70	10	47	54	165	405	53	105	170	199	165	105	56	162	370	132
71	1	41	49	149	358	49	93	159	184	156	99	56	145	329	120
71	2	29	39	149	384	37	88	161	187	156	90	39	144	348	109
71	3	15	23	132	390	18	73	151	176	145	72	19	124	347	88

PART 16.- FIN (DORSAL, TIP, AND STATION 124) SKIN AND AIR TEMPERATURES.

TABLE I (CONTINUED)



LEGEND

A- AIR THERMOCOUPLE
S- SKIN THERMOCOUPLE

DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING.
FOR MOUNTING TYPE DETAILS SEE FIGURE 3

FLIGHT NO.	RUN NO.	AMBIENT AIR (°F)	TEMPERATURE (°F)									
			S104	S102	S100	S99	S101	S103	S105	A58	A57	A59
70	2	-37	-20	63	165	147	165	—	-20	103	340	78
70	3	-17	3	91	196	178	200	—	3	141	390	114
70	5	13	28	110	199	186	194	—	28	161	364	131
70	7	31	42	119	199	180	187	—	45	168	360	145
70	9	50	60	115	171	164	160	—	57	159	325	135
70	4	-17	-4	81	178	163	173	—	-3	124	360	94
70	6	13	30	105	186	177	176	—	28	149	360	119
70	8	29	35	95	178	163	168	—	40	139	333	110
70	10	47	54	105	167	167	163	—	58	147	335	125
71	1	41	50	99	165	157	165	—	58	135	295	114
71	2	29	40	92	166	157	163	—	42	130	309	108
71	3	15	21	78	154	145	149	—	23	110	300	88

PART 17-FIN (STATION 170) SKIN AND AIR TEMPERATURES.

TABLE I (CONCLUDED)

A-33

A-33

FLIGHT CONDITION (SEE TEXT)	FLIGHT no.	RUN no.	PRESSURE ALTITUDE ft	CORRECTED INDICATED AIRSPEED (mph)	MANIFOLD PRESSURE (in. Hg)		rpm		AMBIENT AIR °F	SUPER-CHARGER BLOWER SETTING	FLIGHT ATTITUDE
					LEFT	RIGHT	LEFT	RIGHT			
1	104	2	18,000	118	35.8	—	2,400	0	23	HIGH	DESCENT
	104	3	14,000	117	39.9	—	2,400	0	41	HIGH	DESCENT
	104	4	13,000	114	40	—	2,400	0	45	HIGH	LEVEL
	104	5	10,240	116	40	—	2,400	0	52	HIGH	CLIMB
	104	1	5,000	117	40	—	2,400	0	75	LOW	CLIMB
2	103	1	18,000	137	29.2	—	1,900	0	22	HIGH	400 ft/min DESCENT
	103	2	10,000	142	23.8	—	1,900	0	50	LOW	
	103	3	6,000	140	24.0	—	1,900	0	59	LOW	
3	103	4	10,000	128	35.7	—	2,400	0	50	HIGH	LEVEL FLIGHT
	104	8	6,000	131	37.2	—	2,400	0	74	LOW	
4	104	6	9,500	130	30	—	1,900	0	57	LOW	DESCENT
2	105	1	18,000	138	—	28.8	0	1,900	21.5	HIGH	400 ft/min DESCENT
	105	2	10,000	137	—	30.6	0	1,900	51	HIGH	
	105	3	6,000	138	—	27.1	0	1,900	64	LOW	
3	105	6	9,900	127	—	40.0	0	2,400	58	HIGH	LEVEL FLIGHT
	105	4	6,000	127	—	35.3	0	2,400	65	LOW	
4	105	5	10,000	127	—	30.0	0	2,400	51	LOW	DESCENT

PART I.-OPERATING CONDITIONS

TABLE II

PERFORMANCE OF WING OUTER PANEL THERMAL ICE PREVENTION SYSTEM OF THE C-46 AIRPLANE DURING SINGLE ENGINE OPERATION

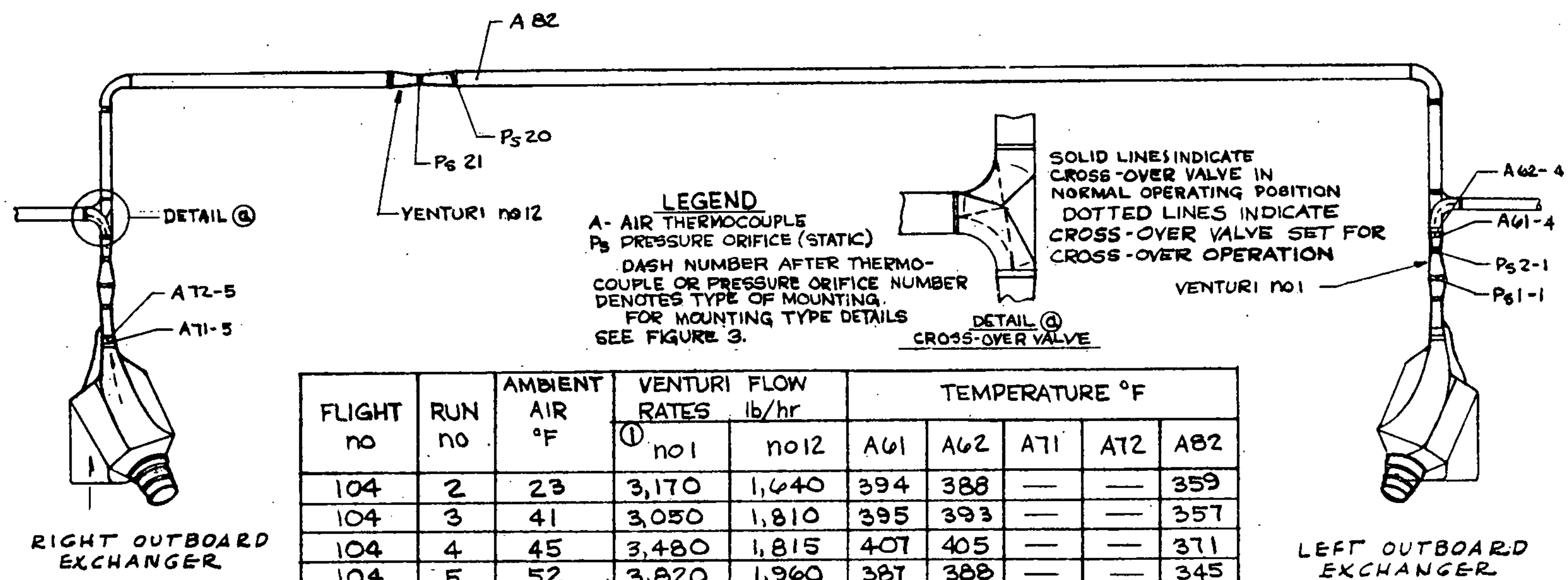
FLIGHT no	RUN no	HEAT FLOWS, 1,000 Btu/hr			HEAT FLOWS PER SQUARE ft. OF DOUBLE SKIN LEADING EDGE SURFACE Btu/hr		④ AVERAGE 0% CHORD LEFT WING TEMP. RISE
		① LEFT OUTB'D EXCHANGER	② TO RIGHT OUTER WING	③ TO LEFT OUTER WING	RIGHT OUTER WING	LEFT OUTER WING	
104	2	283	135	137	1,270	1,290	79
104	3	262	139	107	1,310	1,010	74
104	4	306	144	147	1,360	1,390	79
104	5	314	140	153	1,320	1,440	68
104	1	354	170	169	1,600	1,590	74
103	1	287	135	135	1,270	1,270	77
103	2	298	140	139	1,320	1,310	70
103	3	296	137	141	1,290	1,330	66
103	4	325	152	156	1,430	1,470	78
104	8	357	168	168	1,580	1,580	71
104	6	292	170	105	1,600	990	68
105	1	—	—	136	---	1,290	80.5
105	2	—	—	142	—	1,340	71
105	3	—	—	147	—	1,390	69
105	6	—	—	159	—	1,505	80
105	4	—	—	153	—	1,450	78
105	5	—	—	144	—	1,360	72

① TEMPERATURE RISE USED TO CALCULATE HEAT TRANSFERRED = (A_{62} - AMBIENT AIR TEMP.) °F
② MEASURED AT VENTURI # 12 IN CROSS OVER DUCT
③ (ABOVE TRIPLE LINE) CALCULATED ON BASIS OF VENTURI #1 MINUS VENTURI #12 AIR FLOW RATES (BELOW TRIPLE LINE) MEASURED AT VENTURI #12 IN CROSS OVER DUCT.
④ AVERAGE OF 0% CHORD TEMPERATURES AT STATIONS 159, 380, AND 455.

PART 2.- HEAT DISTRIBUTION
TABLE II (CONTINUED)

A-33

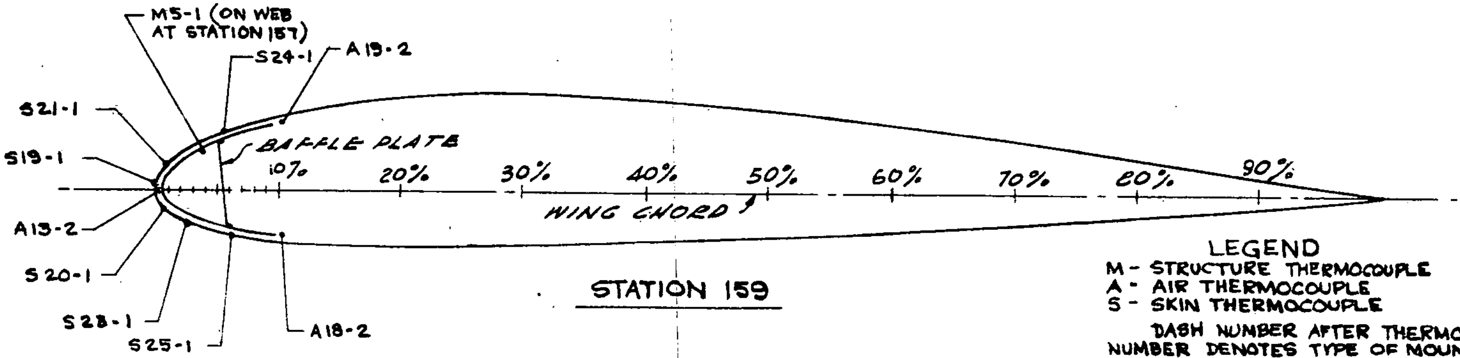
A-33



FLIGHT no	RUN no	AMBIENT AIR °F	VENTURI FLOW RATES lb/hr		TEMPERATURE °F				
			① no 1	no 12	A61	A62	A71	A72	A82
104	2	23	3,170	1,640	394	388	—	—	359
104	3	41	3,050	1,810	395	393	—	—	357
104	4	45	3,480	1,815	407	405	—	—	371
104	5	52	3,820	1,960	387	388	—	—	345
104	1	75	4,440	2,320	404	405	—	—	375
103	1	22	3,240	1,720	395	385	—	—	345
103	2	50	3,930	2,100	369	361	—	—	325
103	3	59	4,390	2,300	344	336	—	—	304
103	4	50	3,910	2,030	395	390	—	—	357
104	8	74	4,510	2,390	396	397	—	—	362
104	6	57	3,960	2,530	366	360	—	—	333
105	1	21.5	—	1,800	—	—	439	362	333
105	2	51	—	2,160	—	—	405	349	322
105	3	64	—	2,370	—	—	397	347	320
105	6	53	—	2,070	—	—	459	394	368
105	4	65	—	2,455	—	—	455	405	322
105	5	51	—	2,020	—	—	437	372	344

① FLOW RATE BASED ON TEMPERATURE A_{62} AT VENTURI no 1

PART 3.-HEATED AIR TEMPERATURE AND FLOW RATES
TABLE II (CONTINUED)



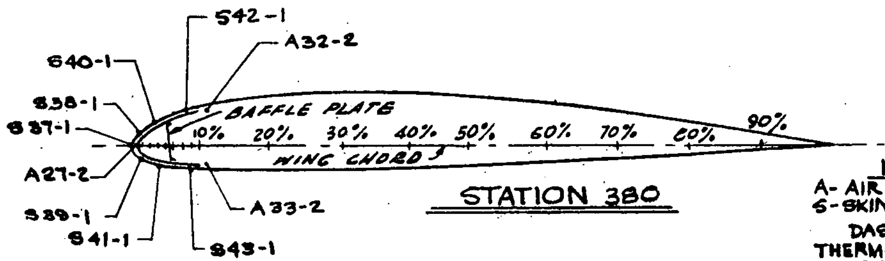
STATION 159

LEGEND
M - STRUCTURE THERMOCOUPLE
A - AIR THERMOCOUPLE
S - SKIN THERMOCOUPLE
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING FOR MOUNTING TYPE DETAILS SEE FIGURE 3.

FLIGHT no	RUN no	AMBIENT AIR °F	TEMPERATURE °F									
			S24	S21	S19	S20	S23	S25	A19	A13	A18	M5
104	2	23	—	122	127	120	132	114	79	221	100	172
104	3	41	—	129	135	132	143	124	92	228	110	179
104	4	45	—	137	143	138	148	126	96	238	109	189
104	5	52	—	132	137	134	144	123	99	229	111	179
104	1	75	—	166	174	173	182	161	129	264	146	216
103	1	22	—	117	124	120	132	114	88	221	100	132
103	2	50	—	138	141	140	151	134	105	230	120	193
103	3	59	—	145	147	145	154	138	110	227	126	188
103	4	56	—	150	154	150	160	138	109	248	123	200
104	8	74	—	160	164	164	174	153	125	257	140	210
104	6	57	—	142	146	145	155	138	108	230	124	190
105	1	21.5	—	118	122	120	133	116	92	207	102	177
105	2	51	—	136	139	140	150	134	112	216	122	183
105	3	64	—	147	151	151	161	145	120	224	134	191
105	6	53	—	149	153	151	162	144	116	239	131	199
105	4	65	—	160	162	161	172	154	126	245	142	208
105	5	51	—	138	142	140	150	135	110	222	123	185

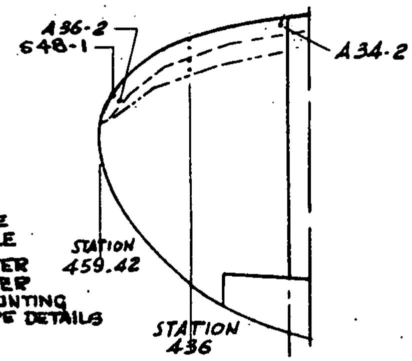
PART 4.- WING OUTER PANEL (STATION 159) SKIN, STRUCTURE & AIR TEMPERATURES
TABLE II (CONTINUED)

A-33



STATION 380

LEGEND
A- AIR THERMOCOUPLE
S- SKIN THERMOCOUPLE
DASH NUMBER AFTER THERMOCOUPLE NUMBER DENOTES TYPE OF MOUNTING FOR MOUNTING TYPE DETAILS SEE FIGURE 9



WING TIP

FLIGHT no	RUN no	AMBIENT AIR °F	TEMPERATURE °F												
			S42	S40	S38	S37	S39	S41	S43	A32	A27	A33	A34	A36	S48
104	2	23	110	130	—	118	128	120	103	102	244	120	200	164	62
104	3	41	119	145	—	131	142	138	115	112	252	132	210	177	78
104	4	45	125	154	—	136	146	138	119	115	260	136	216	182	78
104	5	52	123	150	—	138	147	138	117	115	257	135	213	183	85
104	1	75	152	180	—	165	178	170	150	148	282	159	241	212	108
103	1	22	104	128	—	113	128	118	99	95	242	115	200	157	60
103	2	50	113	146	—	133	148	140	118	113	248	135	212	177	85
103	3	59	120	152	—	138	152	144	124	122	243	141	210	177	92
103	4	50	123	158	—	143	157	148	128	124	265	146	226	187	88
104	8	74	145	174	—	160	173	164	142	137	276	160	237	199	109
104	6	57	133	155	—	137	150	143	125	124	248	140	213	177	92
105	1	21.5	105	132	—	116	133	125	105	104	227	123	194	164	67
105	2	51	121	149	—	136	151	145	125	122	235	142	205	180	91
105	3	64	131	160	—	146	163	155	135	132	240	151	213	190	101
105	6	53	132	165	—	150	167	160	137	134	262	156	229	195	95
105	4	65	142	176	—	160	177	169	147	144	270	166	237	207	106
105	5	51	123	158	—	139	154	147	127	125	244	145	212	179	89

PART 5.- WING (OUTER PANEL STATION 380 AND TIP) SKIN & AIR TEMPERATURES
TABLE II (CONCLUDED)

Figure 1.- The Curtiss-Wright C-46 cargo airplane for which the NACA designed and installed thermal ice-prevention equipment.

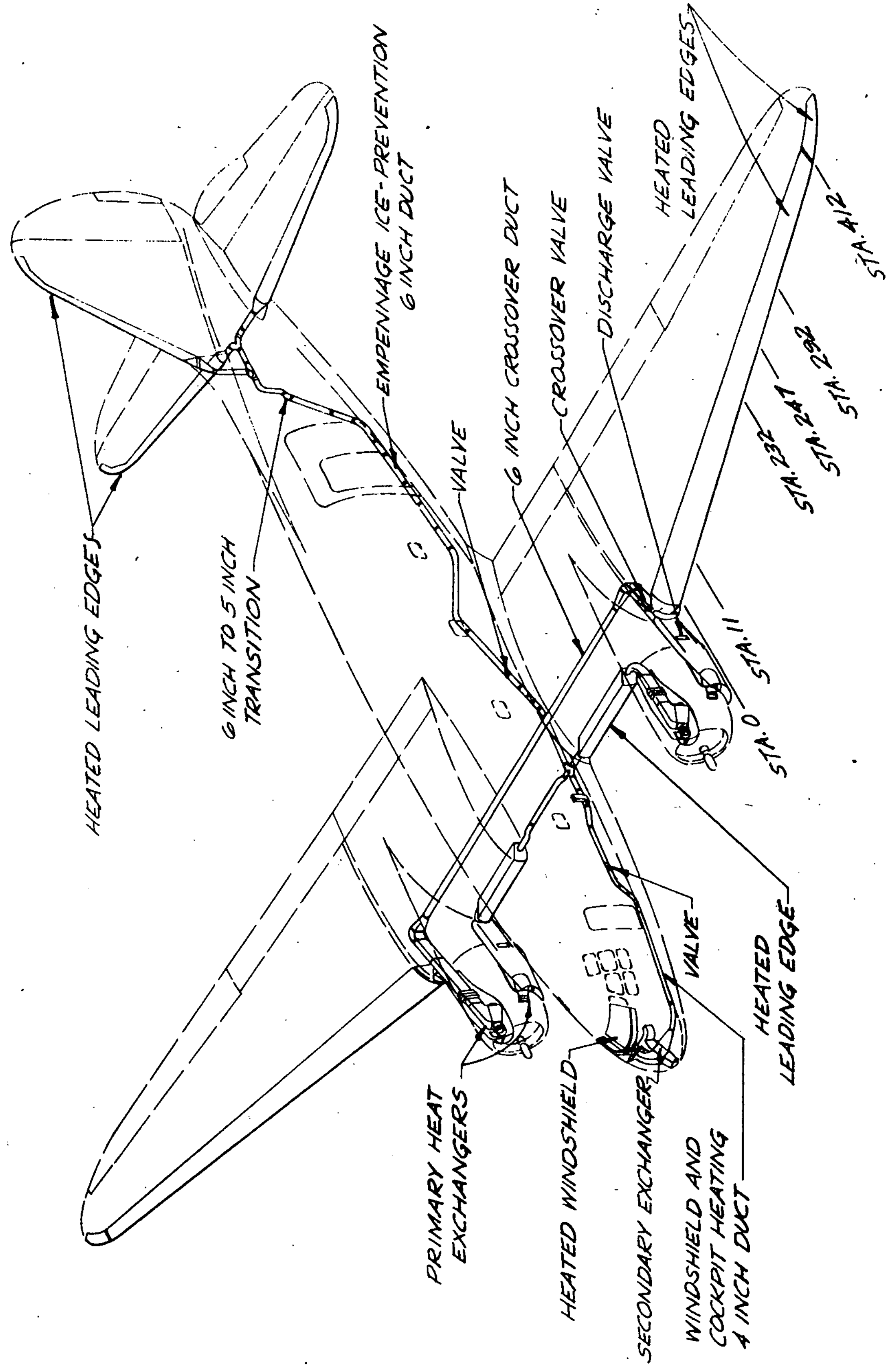
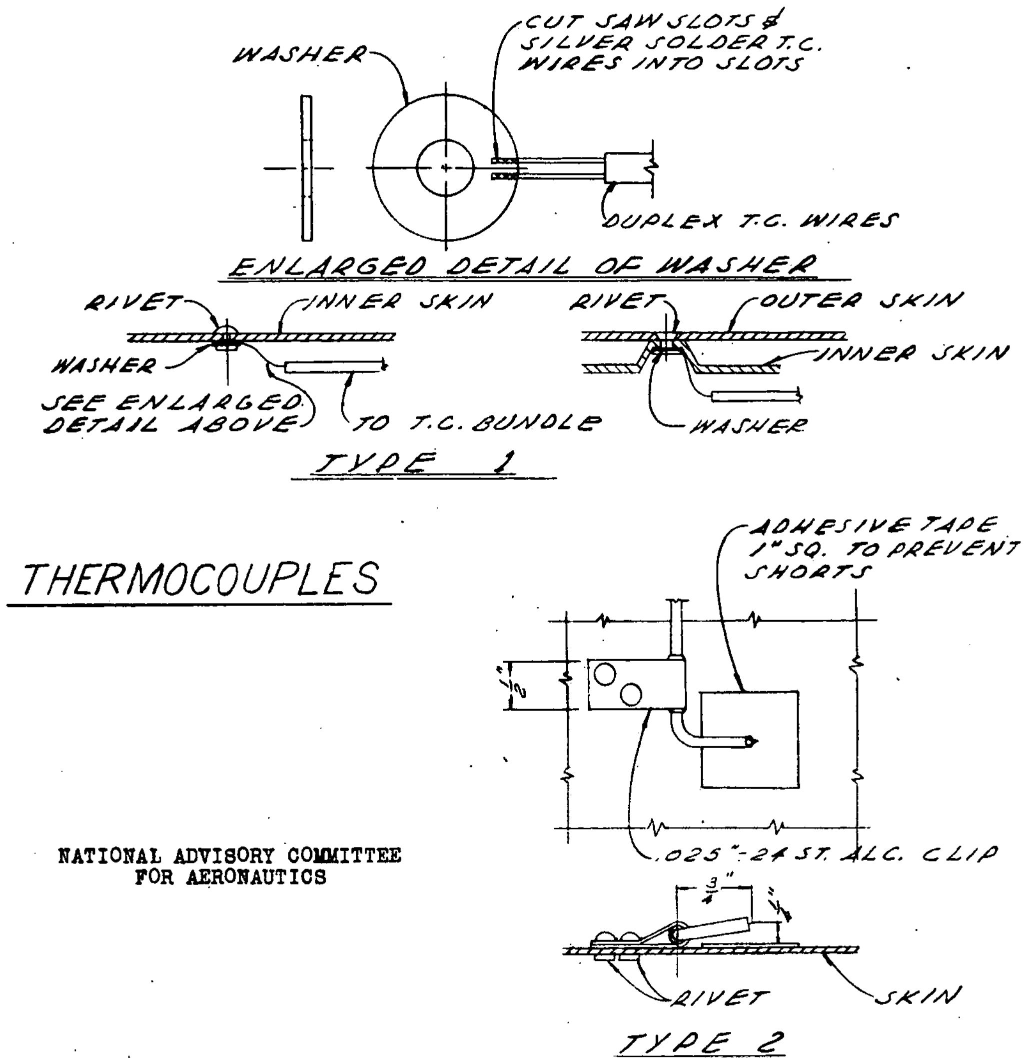


FIGURE 2- GENERAL ARRANGEMENT OF THERMAL ICE-PREVENTION EQUIPMENT IN C-46 AIRPLANE

A-33



NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS

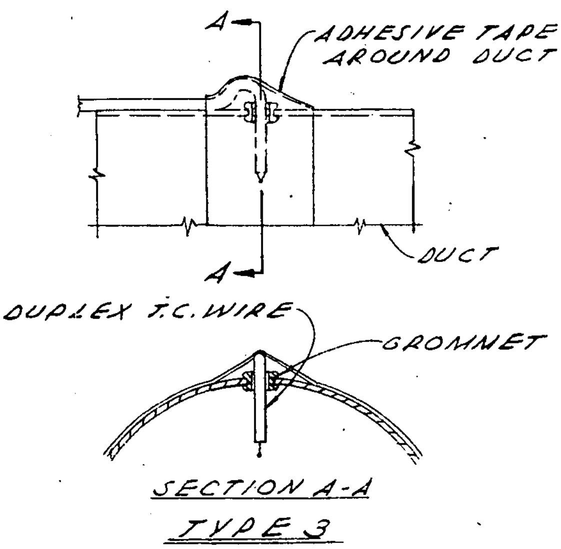


Figure 3 (a to c).- Types of thermocouples and pressure orifice installations used to determine performance of ice-prevention equipment of the C-46 airplane.

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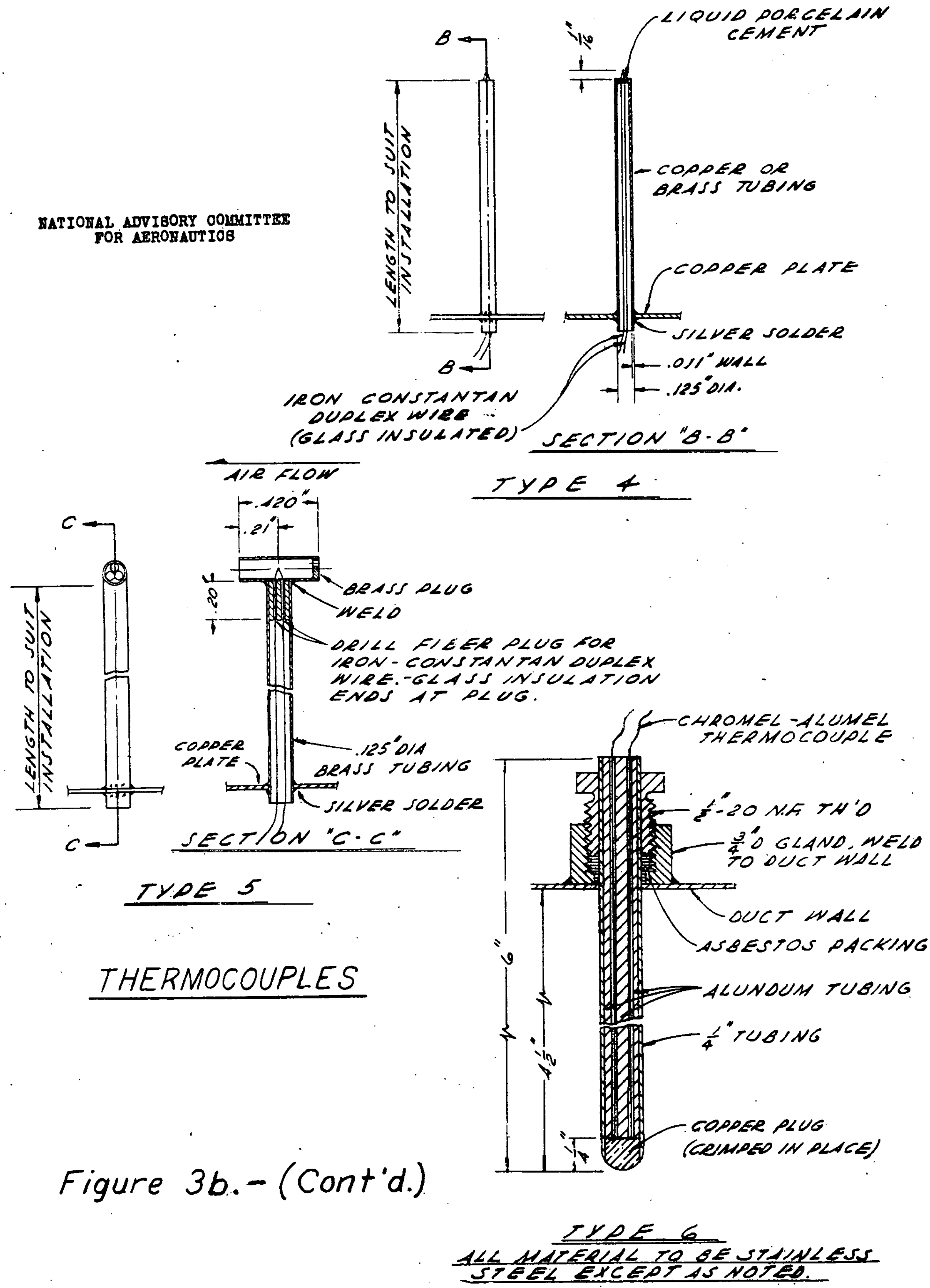
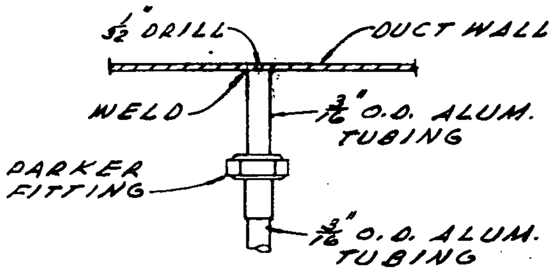
FOR AERONAUTICS



THERMOCOUPLES

Figure 3b.- (Cont'd.)



TYPE 1

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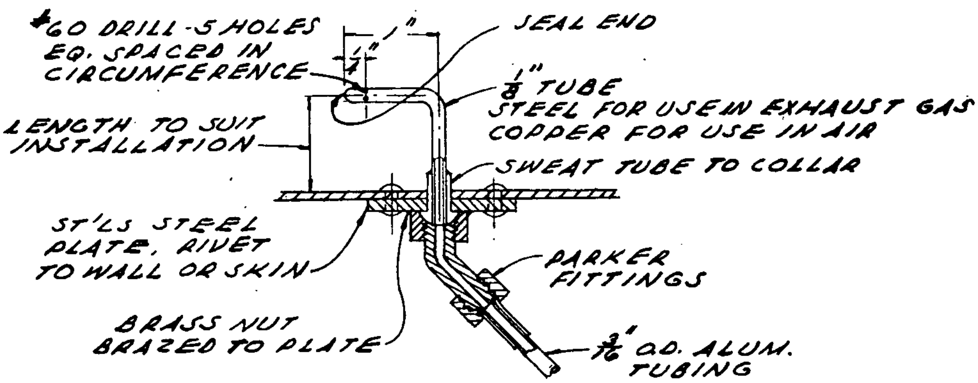
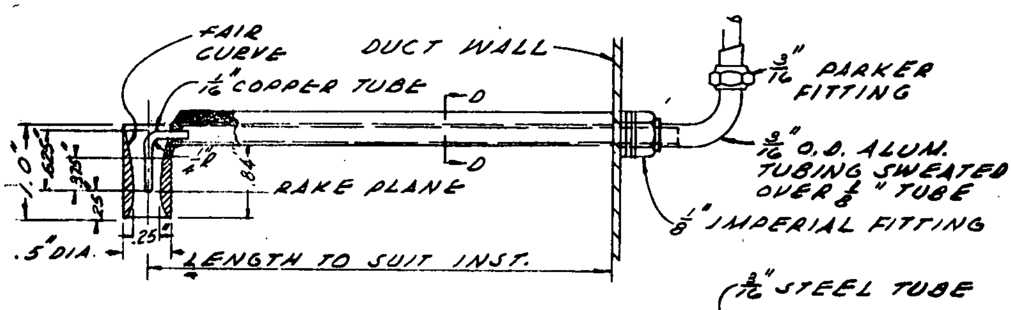


TYPE 2

PRESSURE ORIFICES



TYPE 3

SECTION "D-D"

Figure 3c.- (Concl'd.)

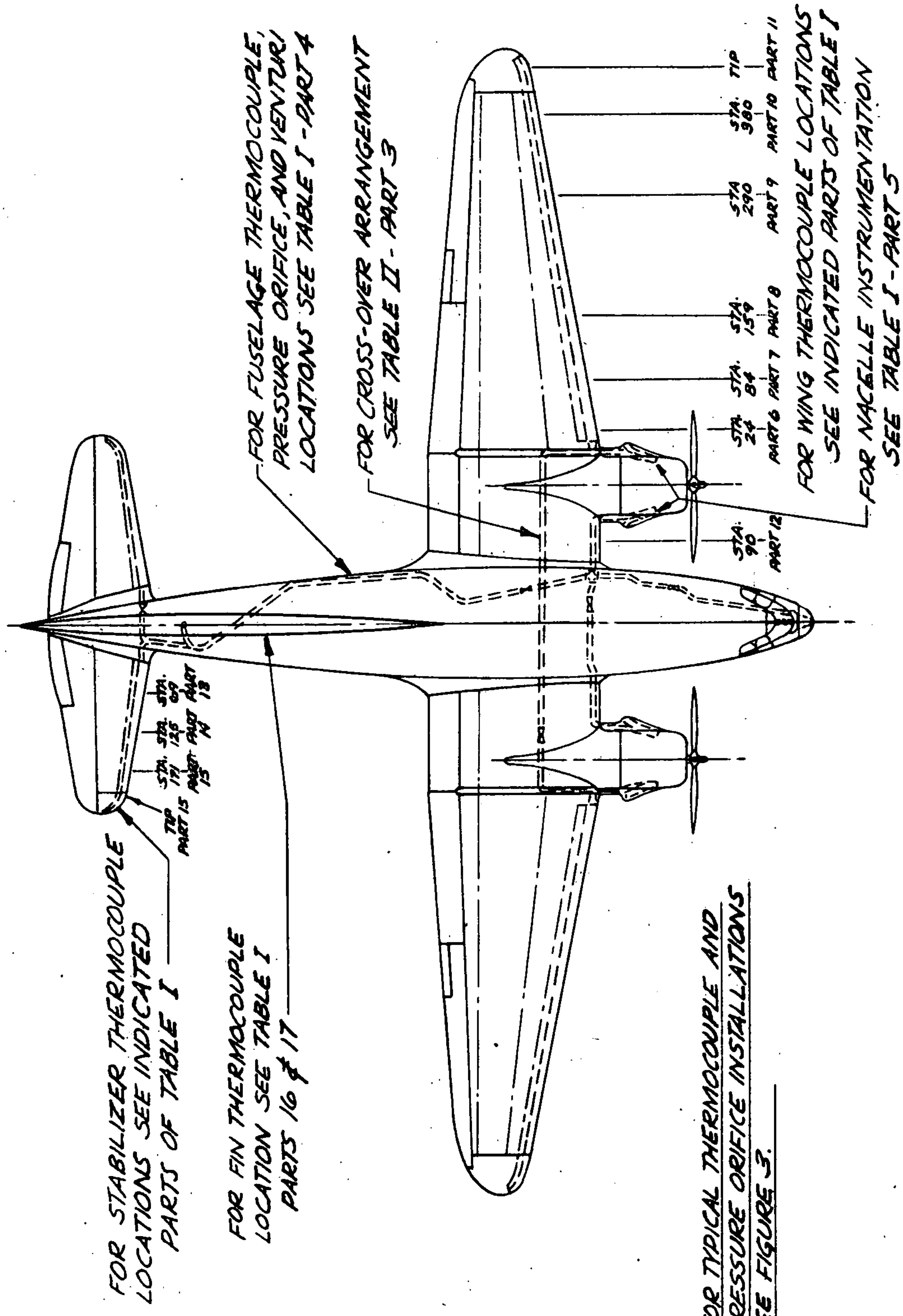


FIGURE 4 - INDEX TO THERMOCOUPLE AND PRESSURE-ORIFICE LOCATIONS ON C-46 AIRPLANE

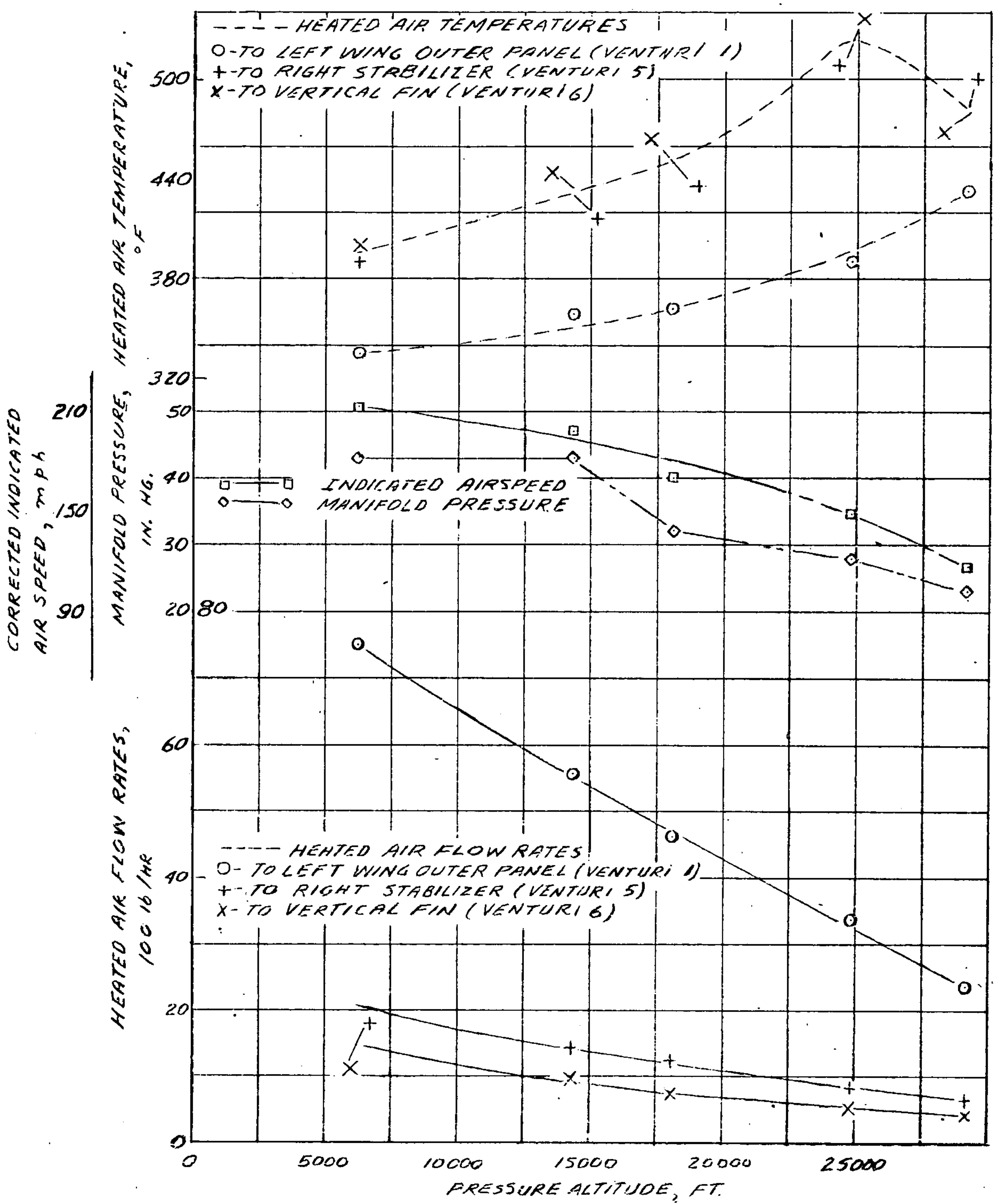


FIGURE 5: VARIATION OF HEATED AIR FLOW RATES AND TEMPERATURES, INDICATED AIRSPEED AND MANIFOLD PRESSURE WITH PRESSURE ALTITUDE. TEST CONDITION 1: FULL THROTTLE; TWIN ENGINE OPERATION. CURTISS-WRIGHT C-46 CARGO AIRPLANE.

A-33

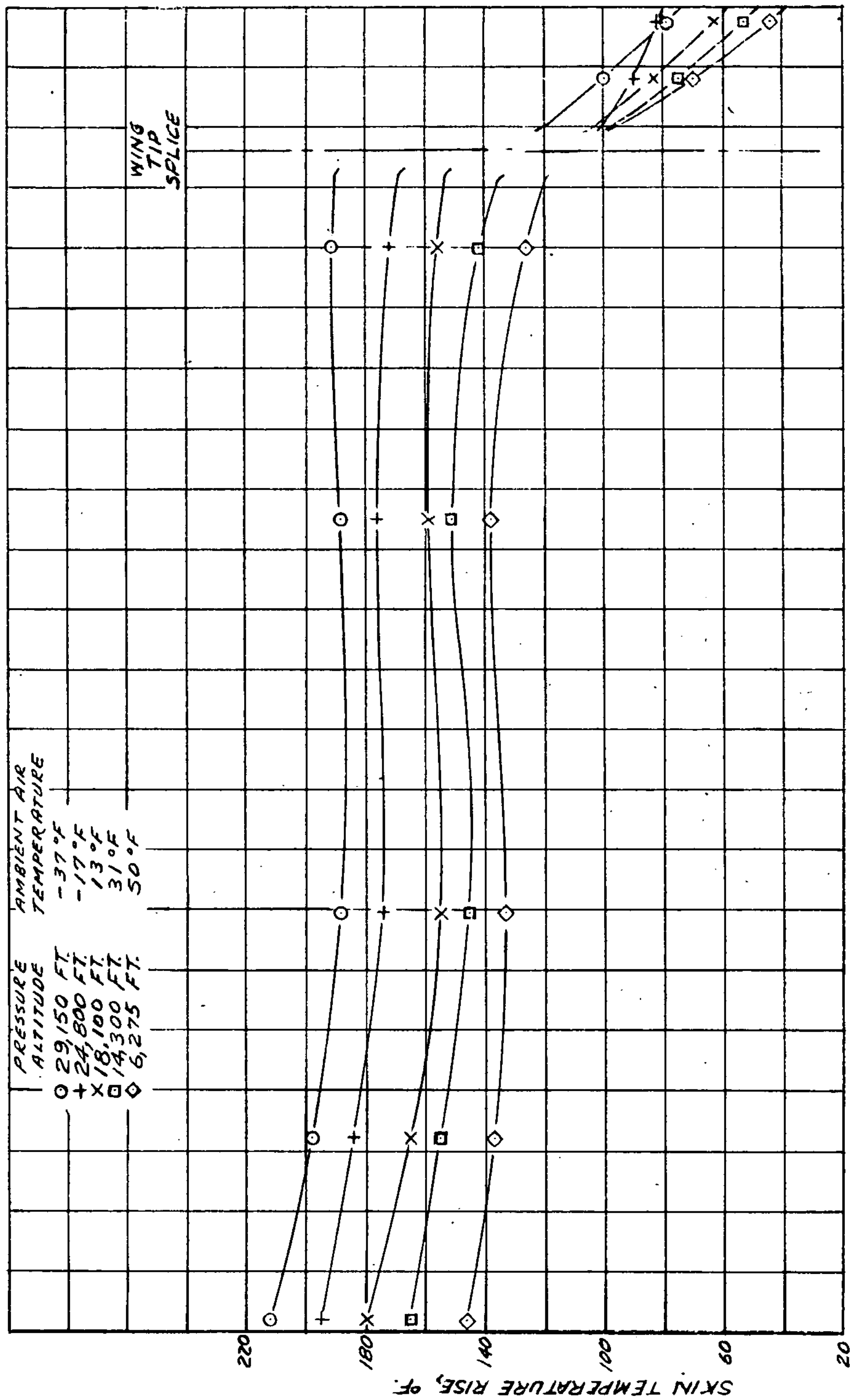


FIGURE 6.- LEFT WING OUTER PANEL 0-PERCENT CHORD SPANWISE TEMPERATURE DISTRIBUTION AT VARIOUS ALTITUDES. TEST CONDITION 1: FULL THROTTLE; TWIN ENGINE OPERATION. CURTISS WRIGHT C-46 CARGO AIRPLANE.

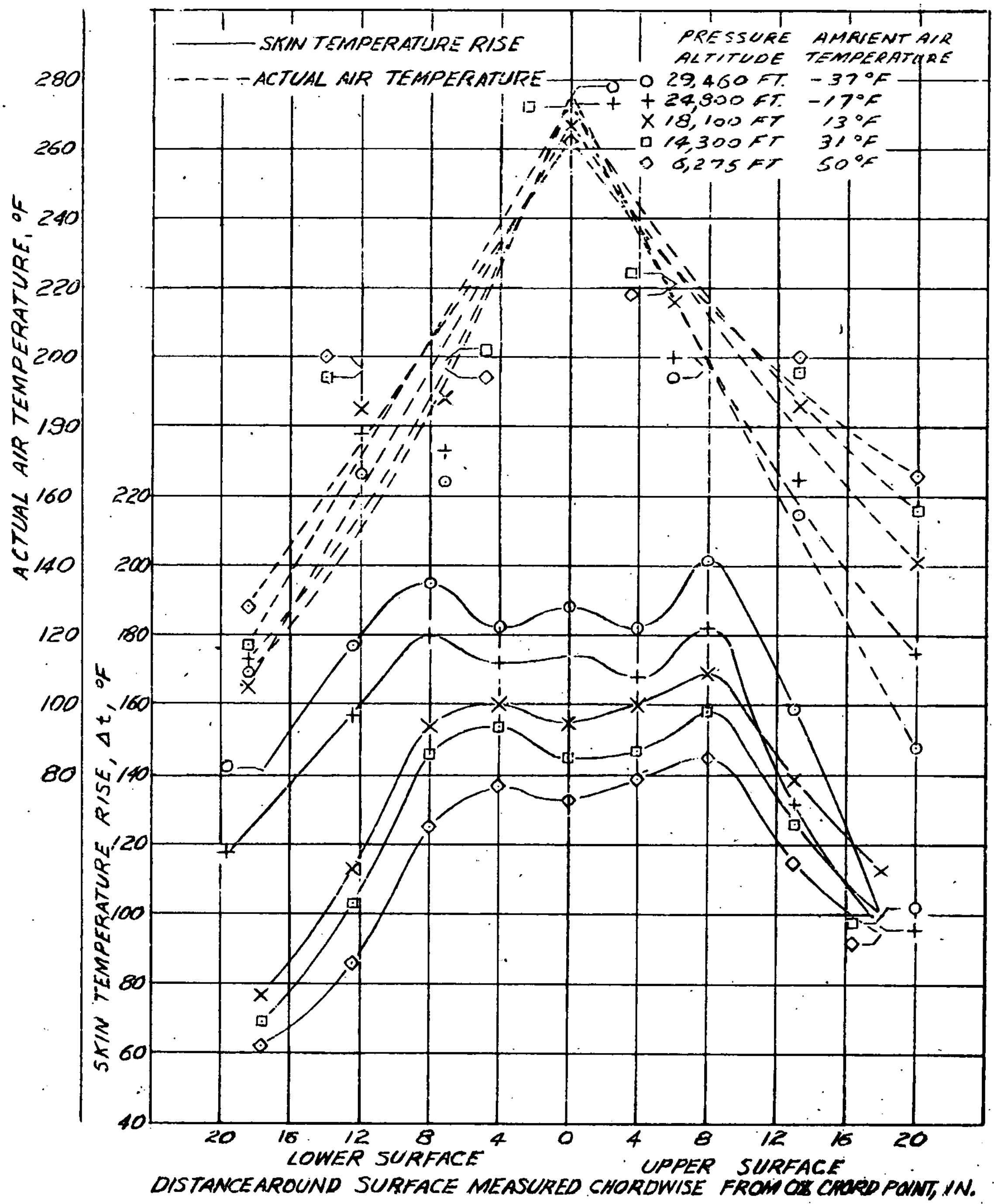


FIGURE 7.- LEFT WING OUTER PANEL STATION 159 CHORDWISE SKIN AND AIR TEMPERATURE DISTRIBUTIONS AT VARIOUS ALTITUDES. TEST CONDITION 1: FULL THROTTLE, TWIN ENGINE OPERATION. CURTISS WRIGHT C-46 CARGO AIRPLANE.

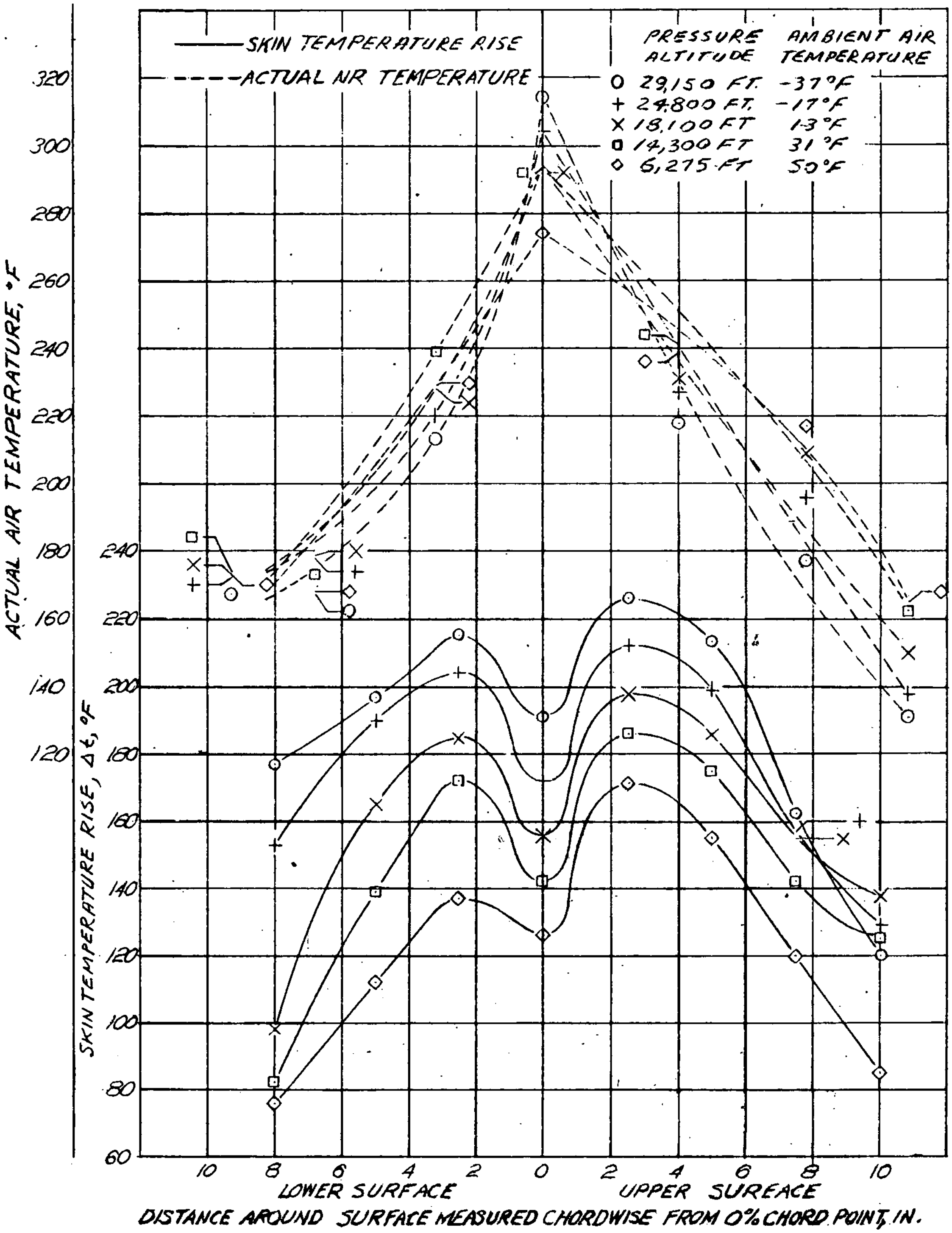


FIGURE 8: LEFT WING OUTER PANEL STATION 380 CHORDWISE SKIN AND AIR TEMPERATURE DISTRIBUTION AT VARIOUS ALTITUDES. TEST CONDITION 1: FULL THROTTLE; TWIN ENGINE OPERATION. CURTISS WRIGHT C-46 CARGO AIRPLANE.

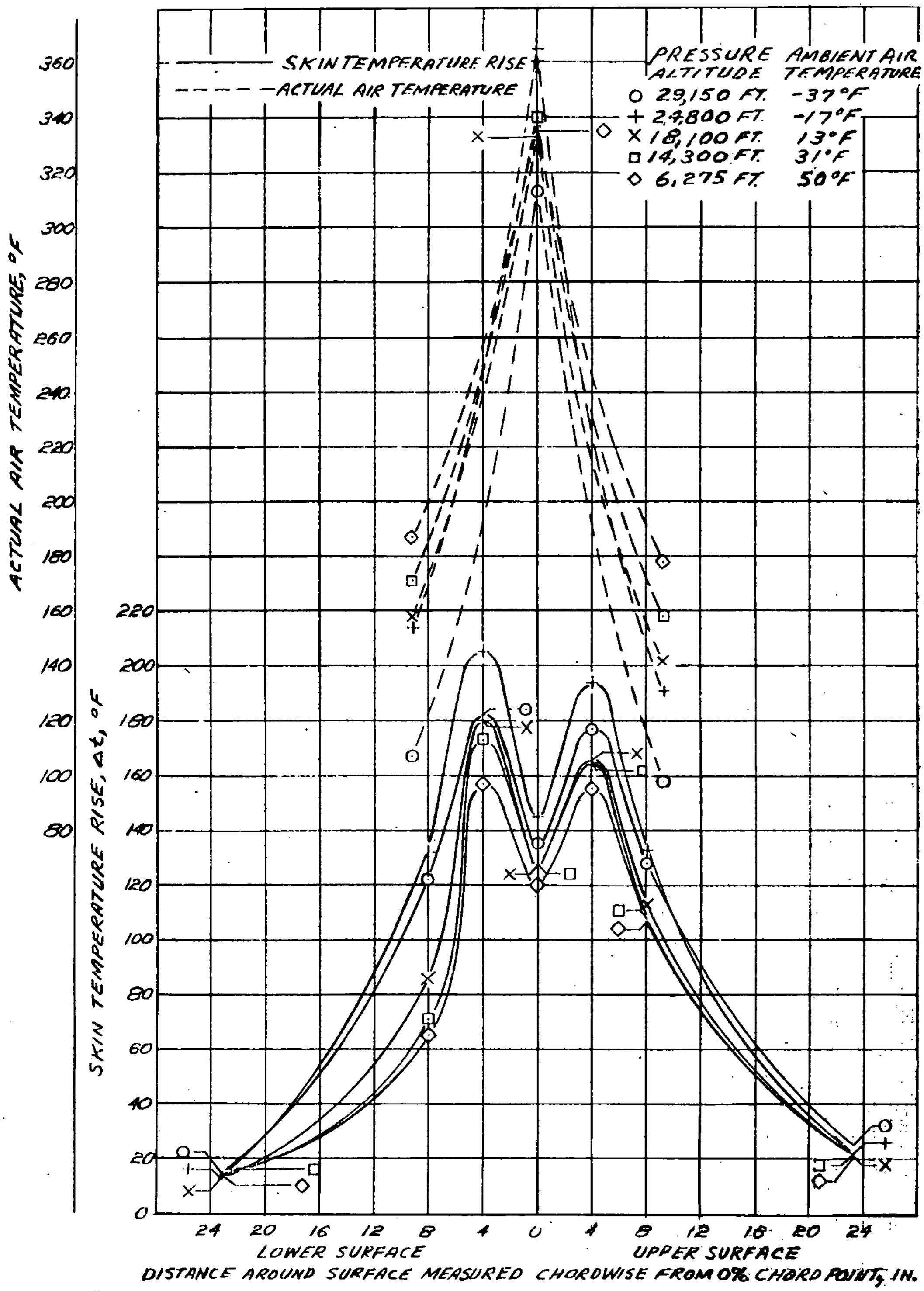


FIGURE 9.- RIGHT STABILIZER STATION 125 CHORDWISE SKIN AND AIR TEMPERATURE DISTRIBUTION AT VARIOUS ALTITUDES. TEST CONDITION 1: FULL THROTTLE; TWIN ENGINE OPERATION. CURTISS WRIGHT C-46 CARGO AIRPLANE.

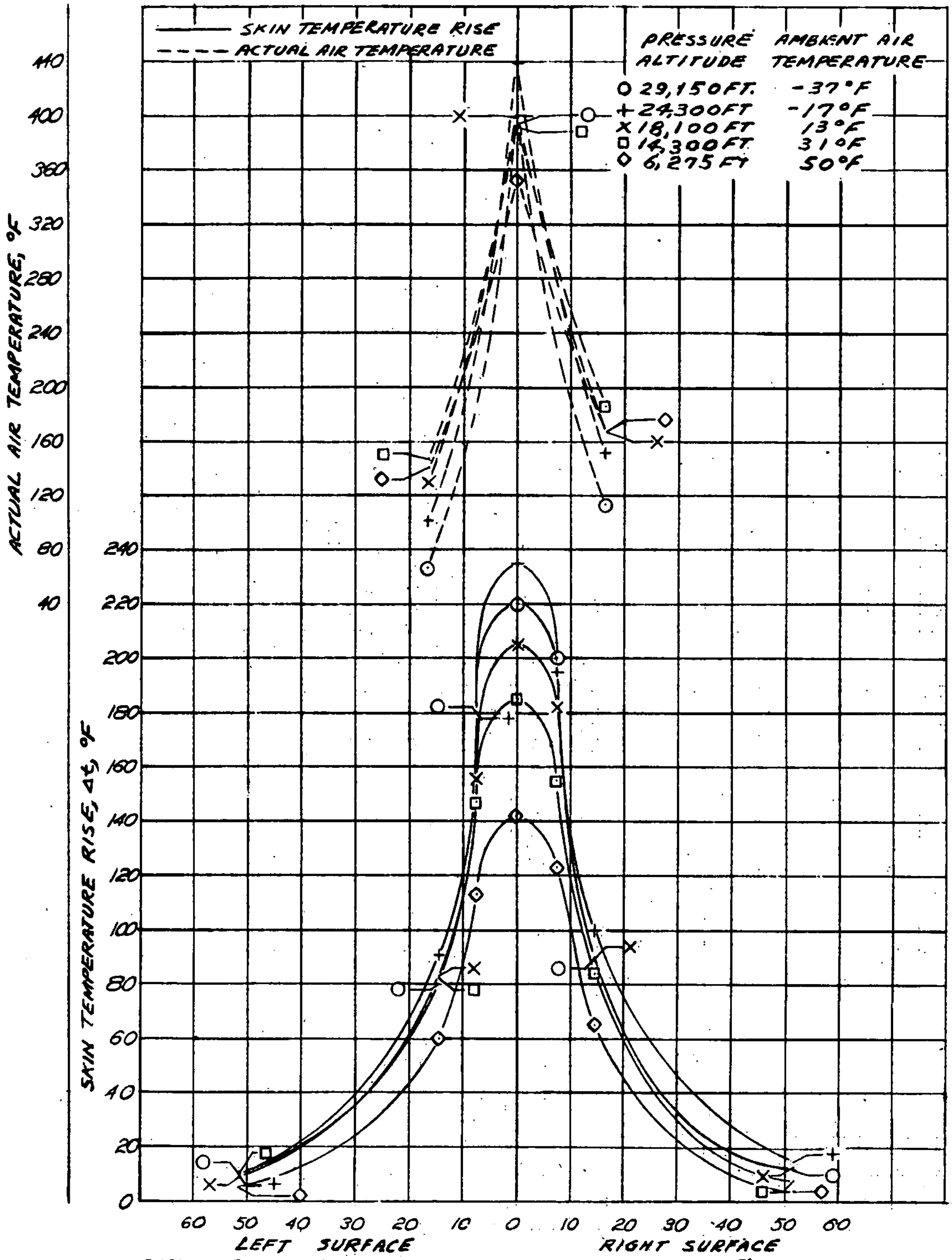


FIGURE 10:- VERTICAL FIN STATION 124 CHORWISE SKIN AND AIR TEMPERATURE DISTRIBUTION AT VARIOUS ALTITUDES. TEST CONDITION I: FULL THROTTLE; TWIN ENGINE OPERATION. CURTISS WRIGHT C-46 CARGO AIRPLANE.

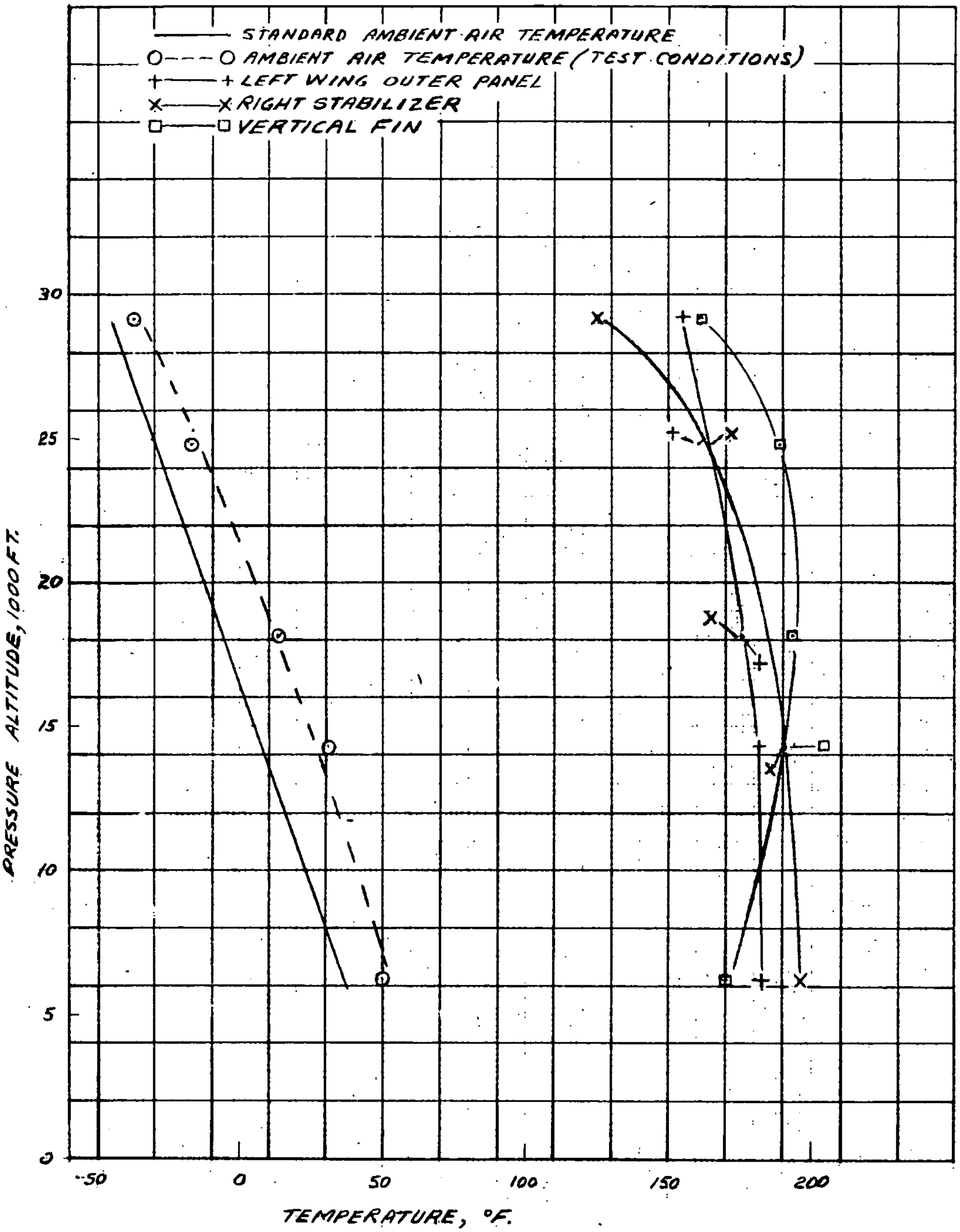


FIGURE 11 - VARIATION WITH ALTITUDE OF AVERAGE SKIN TEMPERATURES FORWARD OF BAFFLE PLATES FOR LEFT WING OUTER PANEL, RIGHT STABILIZER AND VERTICAL FIN. TEST CONDITION 1; FULL THROTTLE, TWIN ENGINE OPERATION. CURTISS WRIGHT C-46 CARGO AIRPLANE.

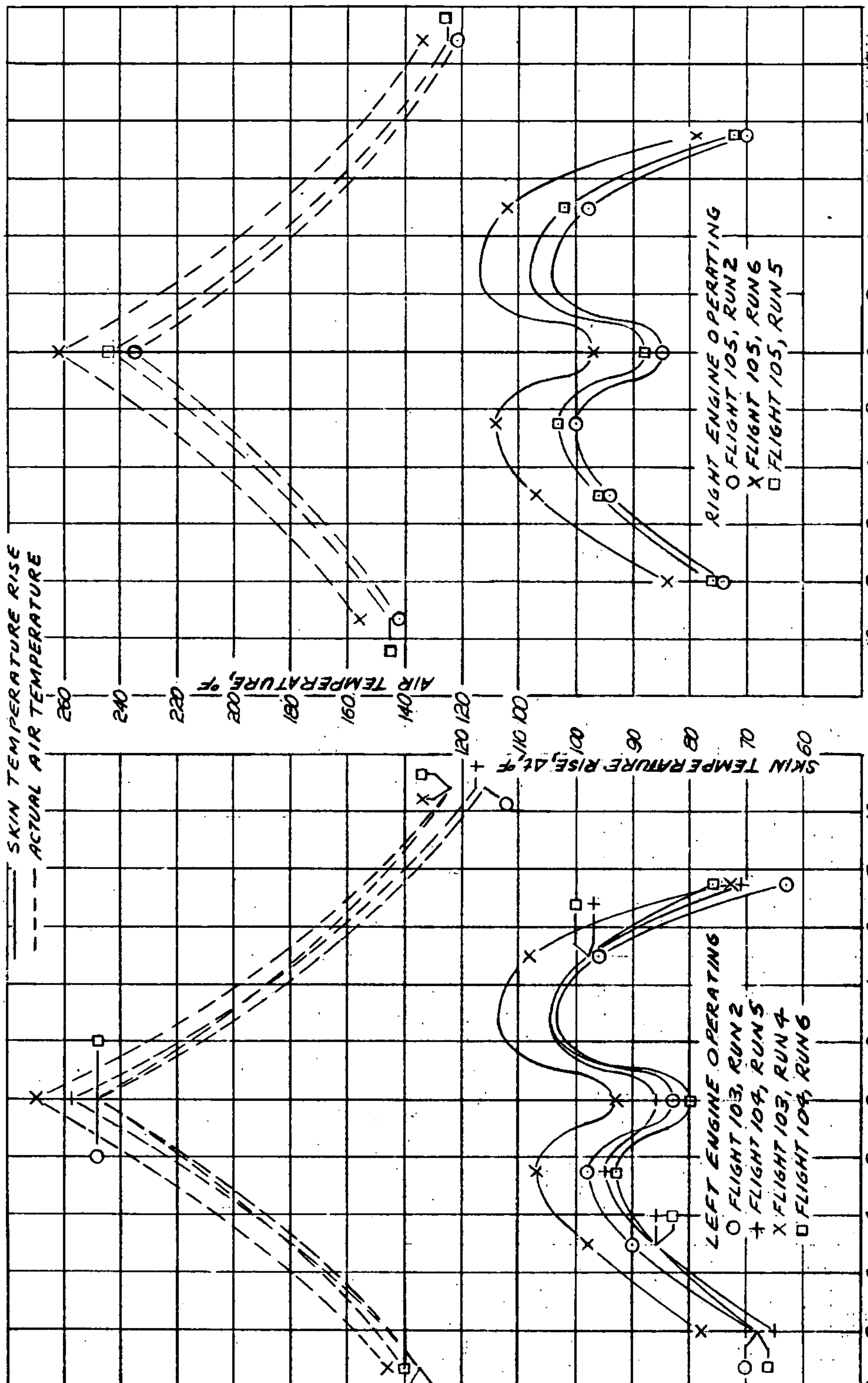


FIGURE 12.- LEFT WING OUTER PANEL STATION 380 SKIN AND AIR TEMPERATURE DISTRIBUTION FOR RIGHT AND LEFT SINGLE ENGINE OPERATION AT 10,000 FEET PRESSURE ALTITUDE, CURTISS WRIGHT C-46 CARGO AIRPLANE.